THIRD EDITION

DALLAS RHINOPLASTY

Nasal Surgery by the Masters

Edited by

ROD J. ROHRICH • WILLIAM P. ADAMS JR • JAMIL AHMAD

JACK P. GUNTER, EDITOR EMERITUS

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THIRD EDITION

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To my parents, Katherine and Claude Rohrich,
for instilling my work ethic at an early age

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making all of us better rhinoplasty surgeons!

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Preface

The first annual Dallas Rhinoplasty Symposium was held in 1984. Having trained in both otolaryngology and plastic surgery, Dr. Jack Gunter recognized a need for rhinoplasty education and an exchange of ideas to further knowledge about this complex surgery. He was one of the first to champion the open approach and to teach the art of rhinoplasty to plastic surgery and otolaryngology trainees, as well as practicing surgeons. Dr. Gunter organized the first symposium and has been an integral part of its growth and evolution into one of the most popular aesthetic plastic surgery meetings. The Dallas Rhinoplasty Symposium has evolved to include didactic lectures, panel discussions, case presentations, surgical video demonstrations, and the anatomy dissection laboratory.

Although attendance has grown dramatically over the years, the Symposium continues to offer an intimate and congenial atmosphere where attendees and faculty have the chance to interact and discuss strategies and approaches for rhinoplasty surgery. Now in its thirty-first year, the Symposium has hosted many preeminent rhinoplasty surgeons over the past three decades and has served to inspire the interest of young plastic surgeons and otolaryngologists with aspirations to develop the necessary knowledge and skillset to perform this complex yet fascinating surgery.

In 2002, the first edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* was published to compile the knowledge and concepts that had been, in large part, developed by faculty who have attended the Dallas Rhinoplasty Symposium. A second edition followed in 2007, with updates to existing chapters and new chapters covering the latest advances in rhinoplasty. The second edition included video content demonstrating anatomy dissections and surgical technique to enhance the multimedia experience for the user.

In the 12 years since the publication of the first edition, we have seen the continued evolution of rhinoplasty surgery, including increased interest in and application of the open approach as well as the further development of techniques that increase precision, control, and consistency. In this third edition, we have updated all chapters with concepts and techniques that have become widely accepted and used by the foremost rhinoplasty surgeons. We have added many new chapters providing practical approaches to key rhinoplasty concepts and other

chapters focusing on ideas and innovations that have been introduced over recent years and have quickly become accepted and practiced, given their utility. We have significantly improved the multimedia experience with greatly expanded video content and new online access to these materials. Throughout the book we have attempted to present information in a thorough yet clear and concise manner so that both novice and expert rhinoplasty surgeons will find this book an efficient and easy to use resource.

Although this book has grown as knowledge in our field has expanded, our objectives remain the same: to assist the nasal surgeon in attaining consistent results using careful preoperative analysis, precise operative planning, meticulous intraoperative execution, and long-term follow-up with critical evaluation of results. It is our sincere hope that this third edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* will continue to be a key resource for surgeons with an interest in rhinoplasty—both those who perform rhinoplasty routinely and those early in their journey to becoming master nasal surgeons.

Rod J. Rohrich
William P. Adams Jr.
Jamil Ahmad

Acknowledgments

Tremendous time and effort go into publishing any plastic surgery textbook, and the third edition of *Dallas Rhinoplasty: Nasal Surgery by the Masters* is no exception. We gratefully acknowledge and thank Karen Berger, Amy Debrecht, and the entire staff at Quality Medical Publishing, who have been with us on this 12-year journey for three editions of this textbook. Their tireless dedication and attention to detail are what make the difference between a medical textbook and a work of art that can be enjoyed by the reader. We would also like to acknowledge Sue Hodgson and CRC Press, who have assumed the role of publishing and distributing this third edition. We would like to thank Sue for her advice and support during production.

We are grateful to the contributing authors who willingly gave of their time, talent, and knowledge to make this edition the best yet. We would like to thank the entire staff, faculty, and residents in the Department of Plastic Surgery at the University of Texas Southwestern Medical Center at Dallas for their contributions and support for all educational endeavors that we undertake. A special thanks goes to Patti Aitson and Martha Aceves, whose expertise in photography, video, and graphic design is seen in many of our publications. We gratefully thank Diane Sinn, senior administrator to Dr. Rohrich for more than 25 years, whose tireless efforts and dedication have made all of us more focused and efficient so we could produce this remarkable book. We also thank Aaron Weinstein, the managing editor for the *Journal of Plastic and Reconstructive Surgery;* Lippincott Williams & Wilkins has generously allowed us to use content that has been previously published in the *Journal.*

We would like to express our appreciation to the following at the University of Texas Southwestern Medical Center at Dallas for their contributions and support of the Dallas Rhinoplasty Symposium over the past 30 years: the Continuing Medical Education Department, the Medical Television Department, and the Willed Body Program. We are grateful to all of the visiting surgeons who have participated as faculty for the Symposium; your ideas and innovations have undoubtedly influenced the evolution of *Dallas Rhinoplasty: Nasal Surgery by the Masters.*

We owe a tremendous debt of gratitude to Dr. Jack P. Gunter, Editor Emeritus of this third edition. Dr. Gunter has been instrumental in the evolution of rhinoplasty technique and the dissemination of knowledge about this complex surgery. Dr. Gunter was the driving force behind the annual Dallas Rhinoplasty Symposium. Over the past 30 years the Symposium has become one of the most popular aesthetic plastic surgery meetings. Dr. Gunter's omnipotent presence and great sense of humor are a fundamental part of what makes the Symposium an excellent educational experience and so enjoyable to attend. Dr. Gunter provided a key impetus behind this textbook and brought the first edition to fruition in 2002. Since then, *Dallas Rhinoplasty: Nasal Surgery by the Masters* has become a global educational staple in rhinoplasty and has enjoyed great popularity among surgeons of all levels interested in learning more about rhinoplasty. Dr. Gunter's endless contributions to nasal surgery have elevated the standard of this surgery to a new stratosphere, ultimately to the benefit of patients and surgeons alike.

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Interpreting the Gunter Rhinoplasty Diagrams

The Gunter rhinoplasty diagrams were introduced in 1989[1] to pictorially document the intraoperative maneuvers in rhinoplasty. At a glance one can see and understand the different techniques used in each patient. Knowing exactly what was done, the surgeon can relate the effect that different surgical techniques have on postoperative results and evaluate their efficacy. The diagrams are also useful for teaching other surgeons the technical steps performed in a rhinoplasty.

The following is the color key for reading the diagrams:

Red = Incisions and excisions
Black = Sutures and outline of anatomic structures
Green = Autologous grafts
Blue = Implants
Orange = Previous incisions or excisions
Pink = Homograft (irradiated cartilage or dermal homograft)

The basic diagrams used for this book were made from a software application developed by Canfield Scientific, Inc. These are generic diagrams; that is, there is only one size dorsal reduction. Thus, if a dorsal reduction is documented, it only tells the reader that one was performed and may not represent the actual size of the reduction. The same is true for resection of the cephalic margins of the lateral crura—there is only one size resection. However, in some of the more unusual cases the diagrams were customized to clarify the author's technique.

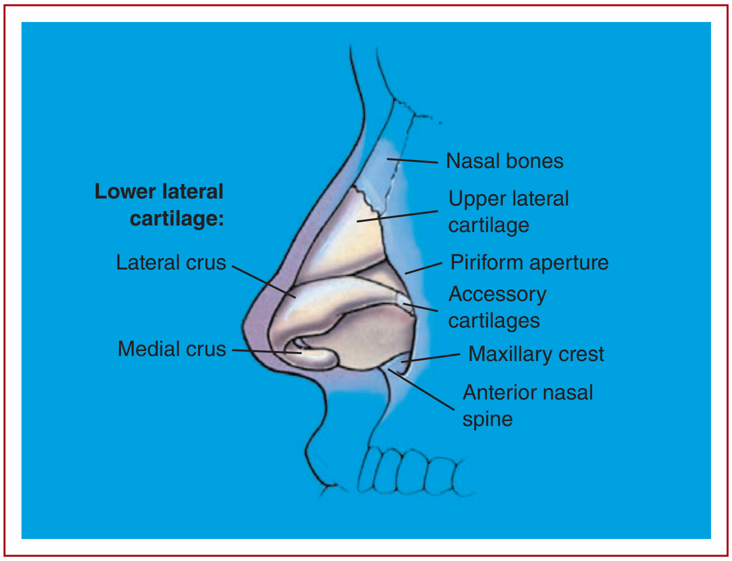
The diagrams illustrate only what the author described in the text. For example, in some of the clinical photographs it may appear that a hump was removed, but this is not included in the diagrams, because we felt uncomfortable trying to interpret what was done by looking at the postoperative photographs and elected to illustrate only what the author specifically described.

REFERENCE

1. Gunter JP. A graphic record of intraoperative maneuvers in rhinoplasty: the missing link for evaluating rhinoplasty results. Plast Reconstr Surg 84:204, 1989.

PART ONE

Basic Perioperative Concepts



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1

Preferred Anatomic Terms for Rhinoplasty

Rod J. Rohrich ▪ Jamil Ahmad ▪ Robert M. Oneal

Precise and universally understood terminology is essential for clear communication in any field. Rhinoplasty surgeons have individually developed and defined a variety of terms to use in nasal analysis and to describe their anatomic findings. During our 30-year experience with presenting the Dallas Rhinoplasty Symposium, we have assembled and refined a lexicon of preferred anatomic terms for use in rhinoplasty. These are terms and definitions derived from and used by the leading educators of the present generation of rhinoplasty surgeons. We hope the following terminology will provide a standardized and universal vocabulary for rhinoplasty surgeons.

accessory cartilages Cartilages connecting the lateral ends of the lateral crura to the piriform aperture edge (Fig. 1-1).

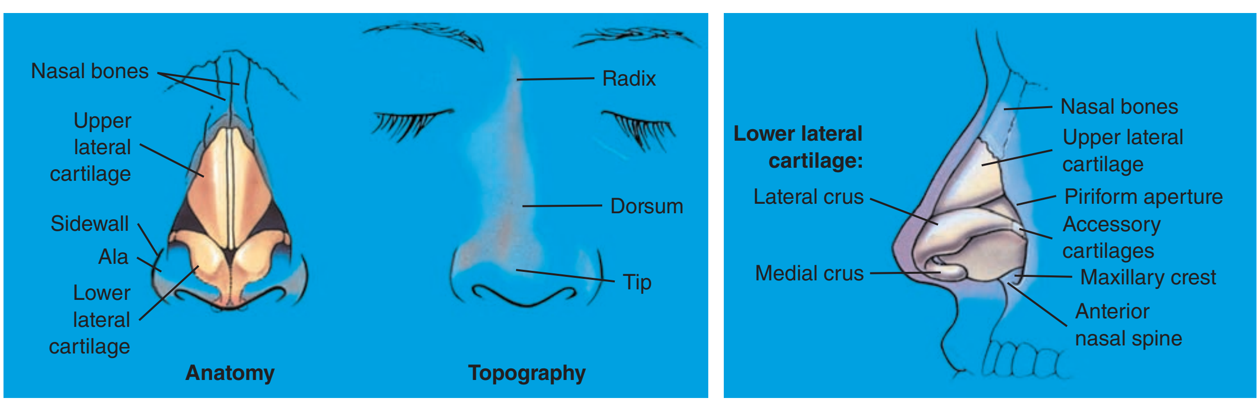


Fig. 1-1

alae The lateral wings. The rounded eminence forming the lateral nostril wall that extends from the tip medially to the nasolabial fold laterally and the nasal sidewall superiorly to the alar rim inferiorly.

alar groove The external oblique skin depression that follows the caudal margin of the lateral crus as it leaves the alar rim to run in a more cephalic direction. It separates the tip superomedially from the thickened portion of the ala inferolaterally and joins the face at the superior cheek-lip junction.

alar rim The inferior free edge of the ala that extends from the tip medially to the nasolabial fold laterally.

anatomic dome Junction of the medial and lateral crura, also known as the *middle crus.*

anterior septal angle The anterior edge of the cartilaginous septum at the juncture of the dorsal and caudal cartilaginous septum (Fig. 1-2).

bony vault The superior third of the nose comprising the nasal bones, frontal processes of the maxilla, and nasal processes of the frontal bone.

caudal Means the same as inferior when referring to the nose.

caudal septum Free inferior border of the septum.

cephalic Means the same as superior when referring to the nose.

clinical dome The anteriormost projecting portion of the lower lateral cartilage. The external projection of the dome is the tip-defining point (Fig. 1-3).

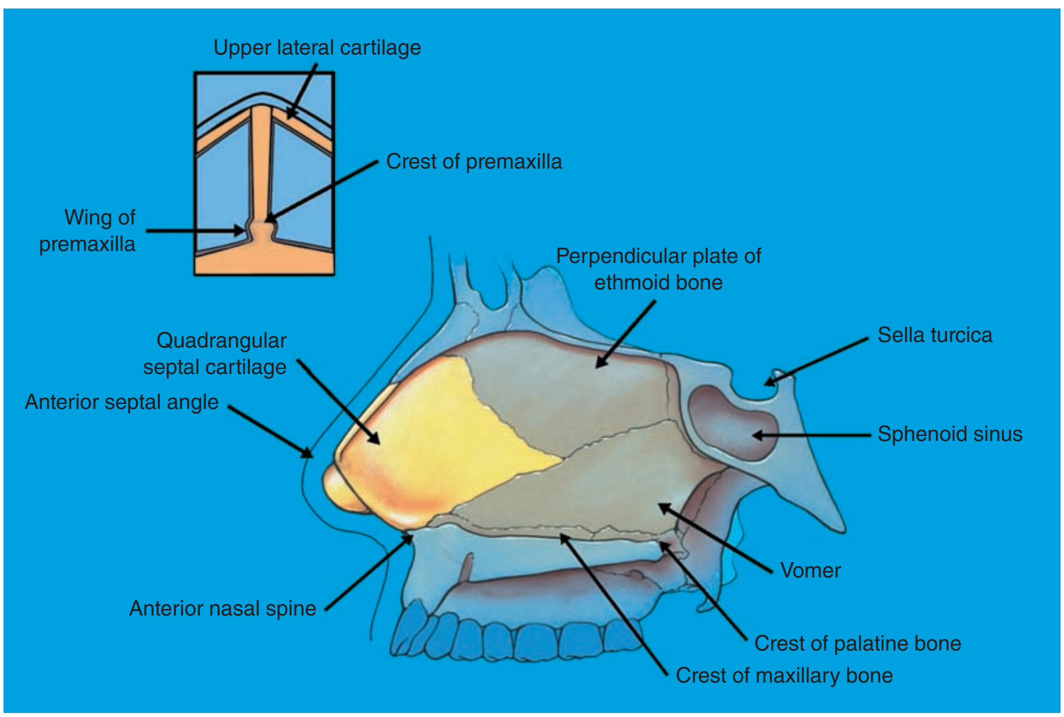


Fig. 1-2

columella The column at the base of the nose separating the nostrils and connecting the tip to the upper lip.

columellar-labial angle Curved junction of the columella with the upper lip (Fig. 1-4).

columellar-lobular angle The angle formed by the junction of the columella with the infratip lobule (see Fig. 1-4).

dorsal Means anterosuperior, in the direction of the nasal dorsum, when referring to the nose.

dorsal aesthetic lines Bilateral light reflexes from the medial aspects of the brow that proceed along the dorsum to the tip.

dorsum of the nose Where the lateral surfaces of the upper two thirds of the nose join in the midline; located between the radix superiorly, the tip inferiorly, and the bilateral nasal sidewalls.

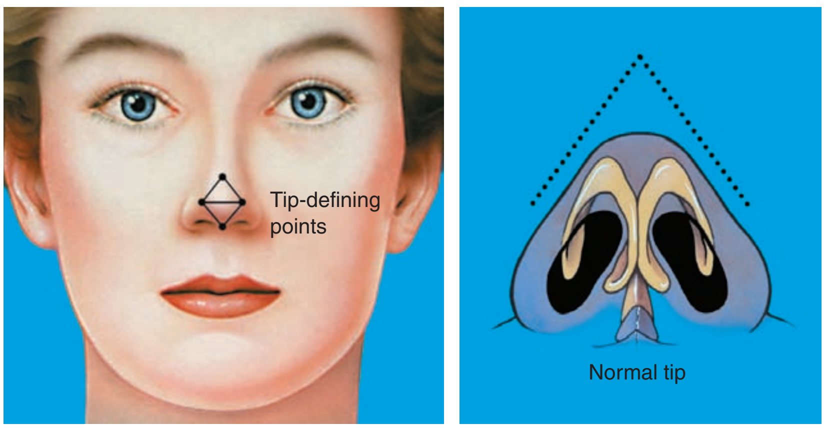


Fig. 1-3

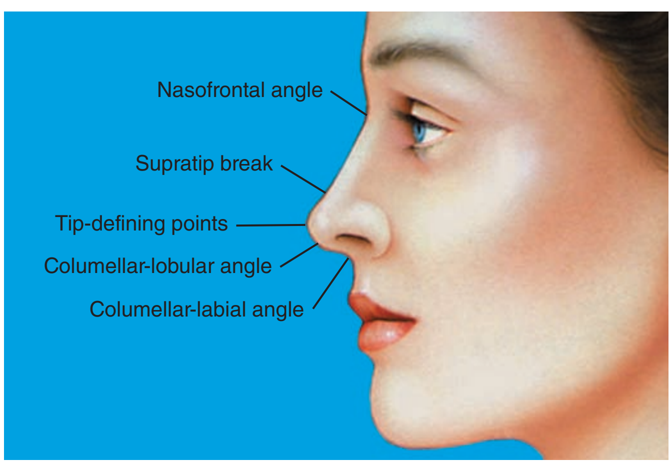


Fig. 1-4

external nasal valve External opening of the nostril bordered by the columella medially, soft triangle anteriorly, alar rim laterally, and upper lip posteriorly (Fig. 1-5).

hemitransfixion incision An incision through the vestibular skin on one side of the membranous septum.

infracartilaginous (marginal) incision An incision of varying length along the caudal border of the medial, middle and lateral crus (Fig. 1-6).

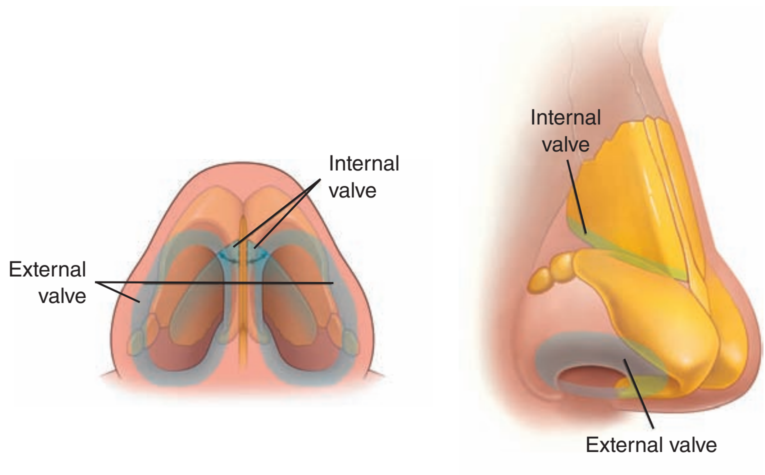


Fig. 1-5

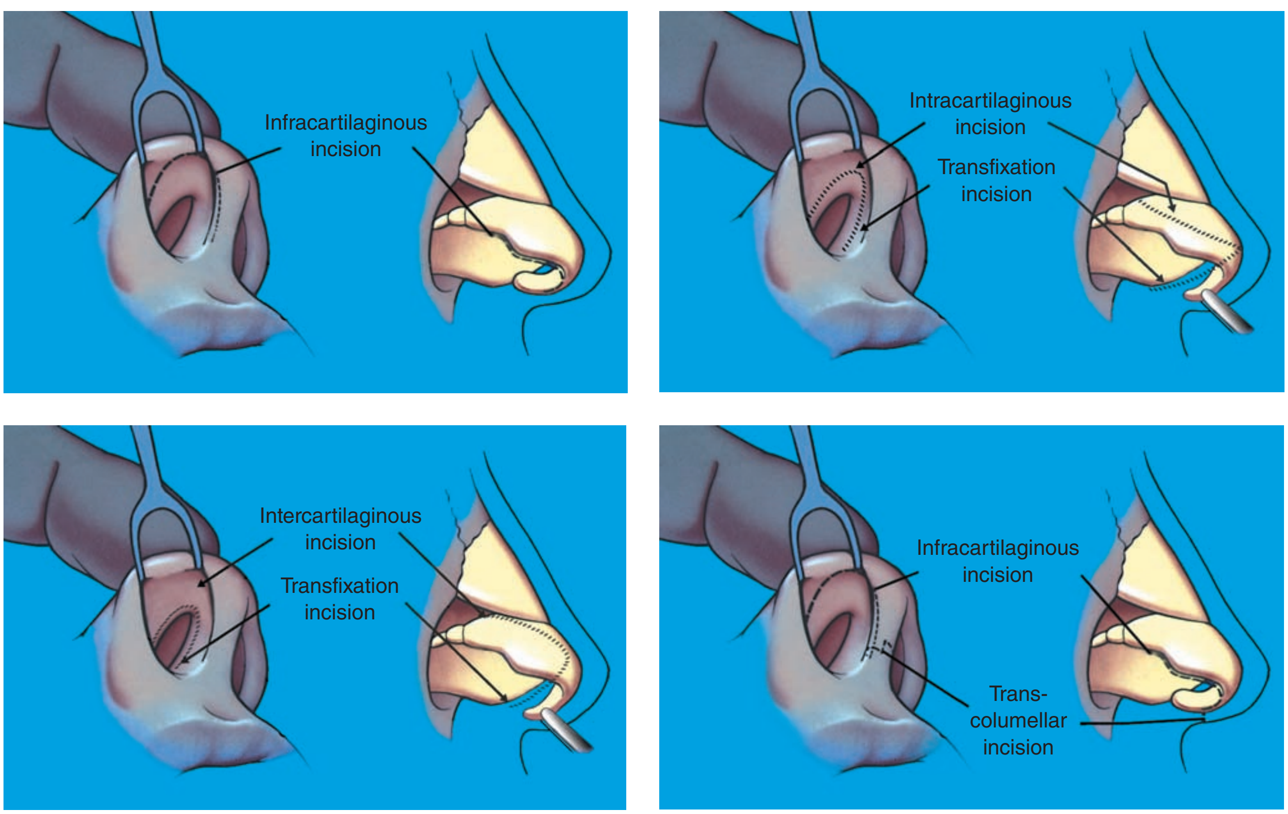


Fig. 1-6

infratip lobule The portion of the lobule between the tip-defining points and the columellar-lobular angle.

intercartilaginous incision An incision placed just on the lower lateral cartilage side of the junction of the upper lateral cartilage with the lateral crus of the lower lateral cartilage.

internal nasal valve The area of the junction of the caudal edge of the upper lateral cartilage with the nasal septum.

intracartilaginous (cartilage-splitting) incision An incision extending medial to lateral through the lateral crus separating the lateral crus into a superior and an inferior portion.

keystone area Junction of the perpendicular plate of the ethmoid with the septal cartilage, nasal bones, and upper lateral cartilages at the dorsum of the nose (Fig. 1-7).

lateral crus The portion of the lower lateral cartilage extending from the anatomic dome medially to the accessory cartilages laterally.

limen vestibule Line of the vestibule; junction of vestibular skin with nasal mucosa; line of junction of the cephalic margin of the lateral crus of the lower lateral cartilage with the caudal edge of the upper lateral cartilage.

lower cartilaginous vault The lower third of the nose comprised of the paired lower lateral cartilages.

lower lateral cartilages The paired inferior nasal cartilages consisting of the medial, middle, and lateral crura.

medial crus The portion of the lower lateral cartilage extending from the upper lip posteriorly to the anatomic dome anteriorly.

middle crus The portion of the lower lateral cartilage that forms the anatomic dome extending from the medial crus to the lateral crus.

naris Nostril.

nasal lobule The lower part of the nose bounded by the anterior nostril edge posteroinferiorly, the supratip area superiorly, and the alar grooves laterally.

nasal pyramid The bony portion of the nose made up bilaterally of the nasal bone and frontal process of the maxilla.

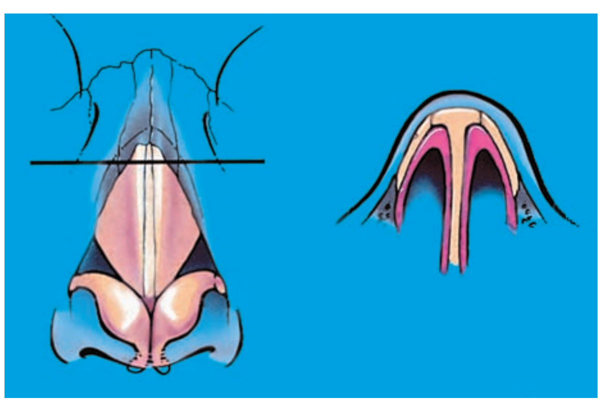


Fig. 1-7

nasal septum Divides the nasal passage into two cavities. It consists of a bony (perpendicular plate of ethmoid, vomer, and premaxillary crest), cartilaginous (quadrangular), and membranous portion.

nasal sidewall The lateral surfaces of the upper two thirds of the nose located between the dorsum medially, cheek laterally and alae inferiorly.

nasofrontal angle Angle of demarcation between the forehead and nasal dorsum; best seen on lateral view.

nasolabial angle Angle seen on lateral view formed by a line drawn through the most anterior to the most posterior point of the nostril intersecting the vertical facial plane. The desired angle in males is 90 to 95 degrees and 95 to 110 degrees in females (Fig. 1-8).

natural horizontal facial plane A horizontal line extending through the lateral facial profile with the head in a normal relaxed position with the eyes looking straight ahead.

periapical hypoplasia Maxillary bone or soft tissue deficiency at the inferior piriform aperture most evident on the frontal and basal views of the nose.

piriform aperture The pear-shaped external bony opening of the nasal cavity.

radix Junction between the frontal bone and the dorsum of the nose.

rim incision An incision placed just within the vestibular edge of the rim of the naris.

scroll area Area of recurvature of the lateral crus of the lower lateral cartilage at its junction with the upper lateral cartilage.

sesamoid cartilages Small cartilages found in the lateral space between the upper and lower lateral cartilages.

soft triangle Thin skin fold between the alar rim and the curved caudal border of the junction of the medial and lateral crura. When this is well defined, it is referred to as a facet.

supratip area The area just superior to the nasal tip at the inferior aspect of the nasal dorsum.

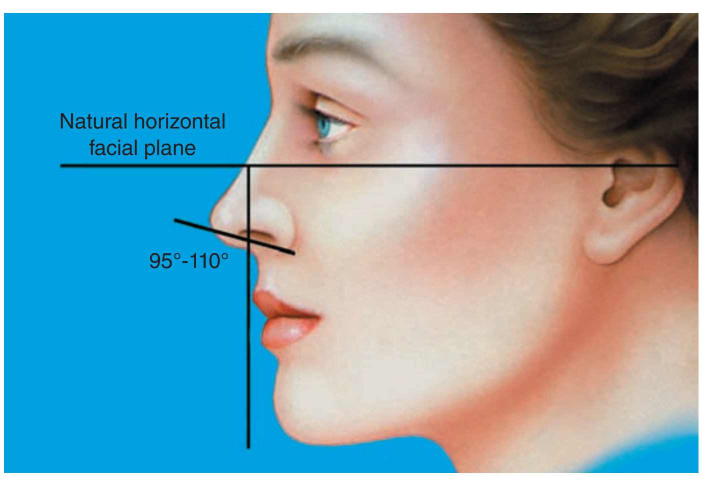


Fig. 1-8

tip Apex of the lobule; also frequently used when referring to the lobule.

tip projection Distance from the tip of the nose to the most posterior point of the nasal-cheek junction seen on lateral and basal views (the distance that the nose projects from the face) (Fig. 1-9).

tip rotation Movement of the tip cephalad or caudad from the fixed alar base.

tip-defining points The most projecting area on each side of the tip, which produces an external light reflex.

transcolumellar incision An incision used for the open rhinoplasty approach through the thin skin of the columella connecting the medial terminations of the infracartilaginous incisions.

transfixion incision An incision in the membranous septum between the caudal border of the septal cartilage and the columella.

turbinates Three scrolls of bone (superior, middle, inferior) projecting from the lateral nasal wall (Fig. 1-10).

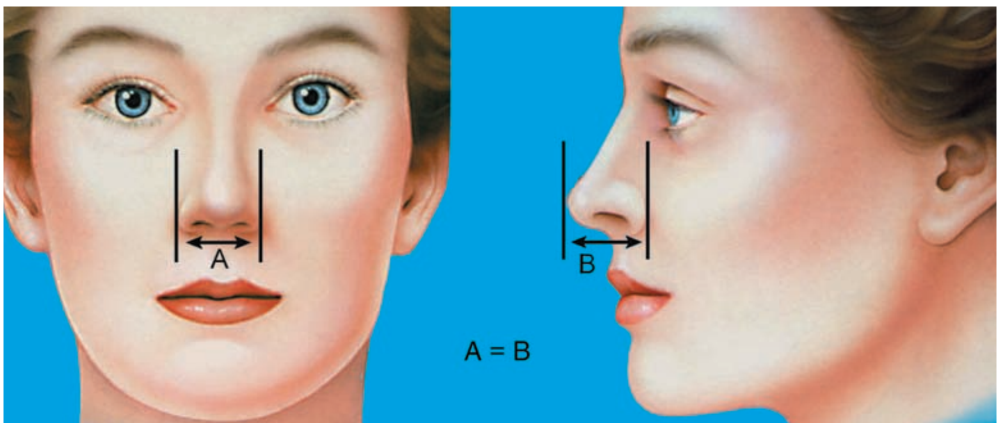


Fig. 1-9

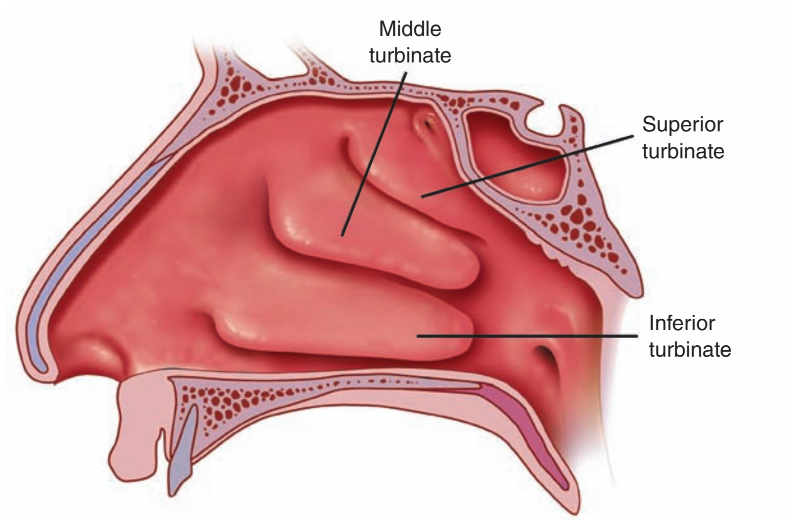


Fig. 1-10

upper cartilaginous (middle) vault The middle third of the nose comprised of the dorsal septum and upper lateral cartilages.

upper lateral cartilages The paired triangle-shaped superior nasal cartilages extending laterally from the dorsal septum that make up the lateral walls of the middle third of the nose.

vertical facial plane A line perpendicular to the natural horizontal facial plane.

weak triangle (Converse) Area superior to paired domes where the cephalic margins of the lower lateral cartilages separate to travel in a superolateral direction.

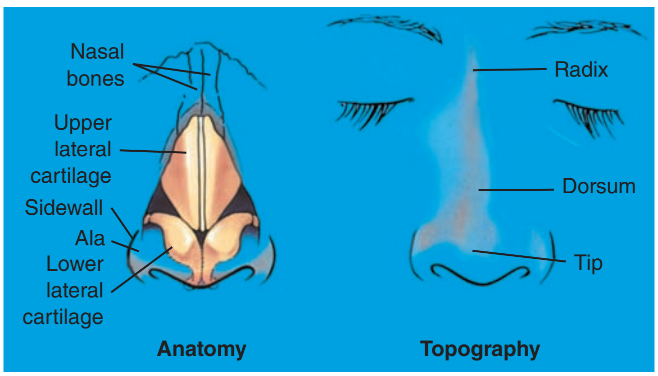
Webster's triangle A triangular bony projection along the pyriform aperture directly lateral to the anterior aspect of the inferior turbinate that is preserved during lateral osteotomies to prevent obstruction of the internal nasal valve.

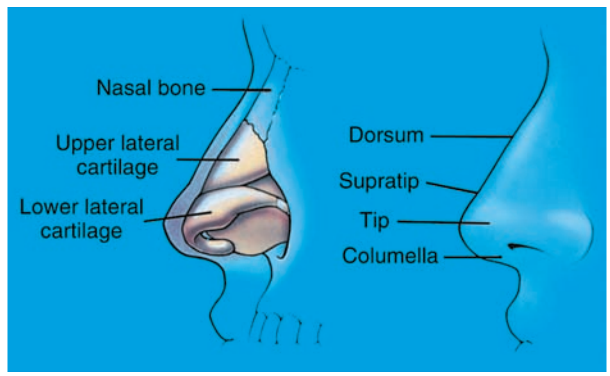
A standardized and universal vocabulary for rhinoplasty allows clear and precise communication among rhinoplasty surgeons, particularly with respect to the process of surgical education and training. Our long experience with the Dallas Rhinoplasty Symposium has enabled us to assemble this glossary of anatomic terms that have been used by the most respected surgical educators in rhinoplasty and to refine them into a vocabulary that can be used and understood by all students of rhinoplasty. As increasing numbers of surgeons have attended the Dallas Rhinoplasty Symposium, many of these terms have become commonplace.

2

Advanced Rhinoplasty Anatomy

Rod J. Rohrich ▪ William P. Adams Jr. ▪ Jack P. Gunter ▪ Jamil Ahmad





Rhinoplasty is precise surgery in which the margin of error is measured in millimeters. Therefore excellent results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy, its variations, and the surgical relevance of altering its structures. Lack of such understanding may result in inaccurate diagnosis and therefore incorrect surgical indications, leading to unfavorable aesthetic outcomes and sometimes serious functional derangements.

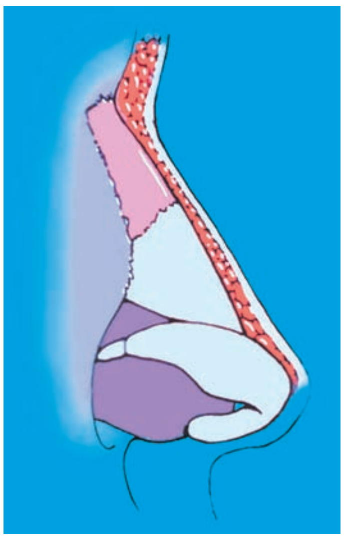
The nose includes a framework, supporting system, external coverage, and internal lining. The framework consists of cartilage and bone, supported and held together by connective tissue and ligaments.[1-6] The skin and soft tissue provide the external covering of the nose. These components are intricately related and must be anatomically visualized in every step of the rhinoplasty sequence. The basic principles of this sequence include the following:

1. Precise definition of anatomic goals preoperatively
2. Adequate anatomic exposure of the nasal deformity
3. Preservation/restoration of the normal anatomy
4. Correction of the specific deformity using incremental control
5. Maintenance/restoration of the nasal airway

In this chapter we will review the clinically relevant anatomy encountered in rhinoplasty as well as the clinical applications of these findings.

Excellent rhinoplasty results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy and a grasp of the surgical relevance of alteration of the anatomic structures.

SKIN



Previous anatomic studies have demonstrated that the nose possesses distinct tissue layers. Proceeding from superficial to deep tissues, the layers encountered are epidermis, dermis, subcutaneous fat, muscle and fascia (musculoaponeurotic layer), areolar tissue, and perichondrium or periosteum overlying cartilage or bone, respectively.[7,8] In fact, three natural planes of dissection have been described (subcutaneous, deep areolar tissue planes, and perichondrial),[9] separating the nose into the skin envelope, vascular musculoaponeurotic layer, and osteocartilaginous framework.

The skin is thinner and more mobile in the upper two thirds of the nose. In the lower third and especially at the nasal lobule, the skin becomes thicker, more sebaceous, and more adherent to the underlying structures.

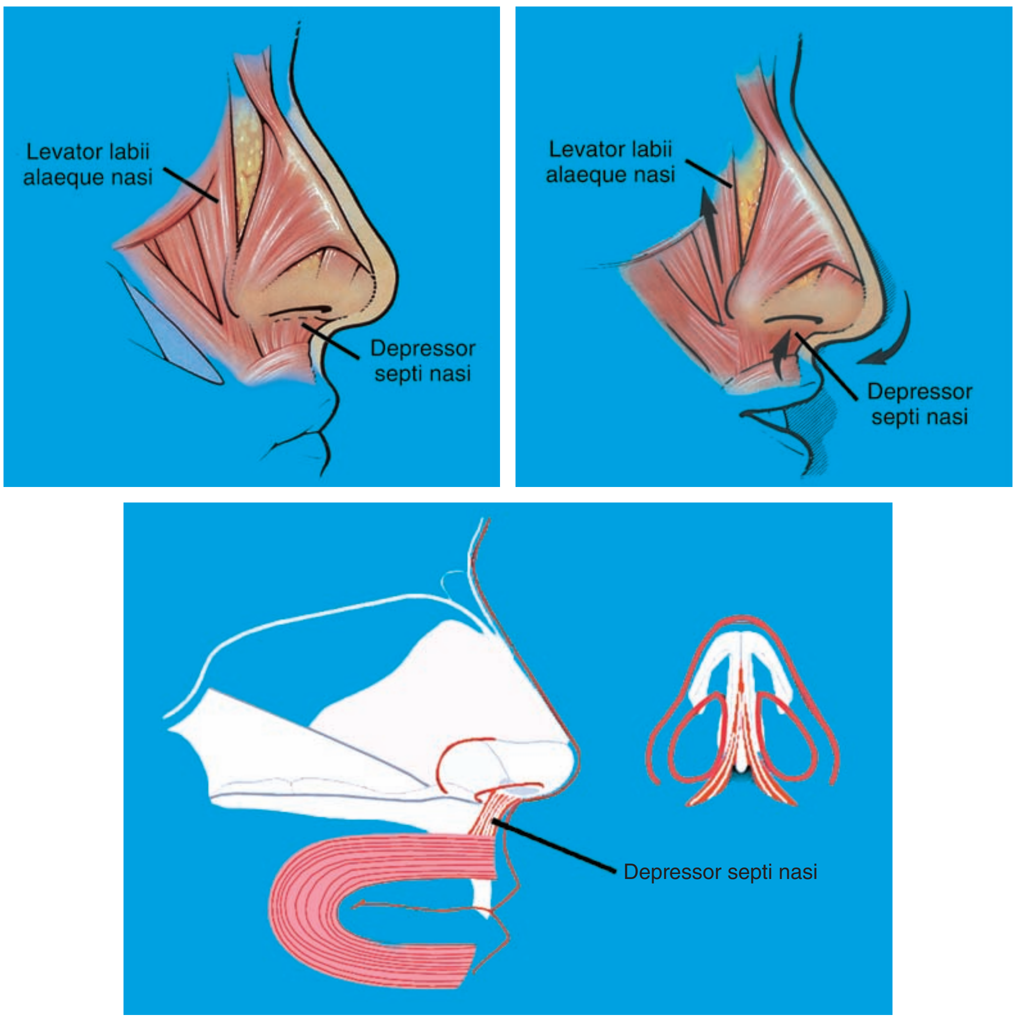
Clinical Applications

The type, texture, and sebaceous content of the skin must be carefully analyzed, because it will influence the approach for modifying the framework and therefore the final result. For example, in patients with thin skin, overzealous alteration of the underlying framework may have adverse long-term effects. This is because thin nasal skin has a high capacity to contract and redrape over the sculpted framework. Additionally, slight imperfections of contour, asymmetries, and graft edges are more likely to be visible and/or palpable postoperatively. In contrast,

thick sebaceous skin tends to offer less postoperative contraction, warranting more aggressive alterations of the underlying framework in order to obtain a significant definition of contour.

The type, texture, and sebaceous content of the skin must be carefully analyzed, because it will influence the approach for modifying the framework and therefore the final result.

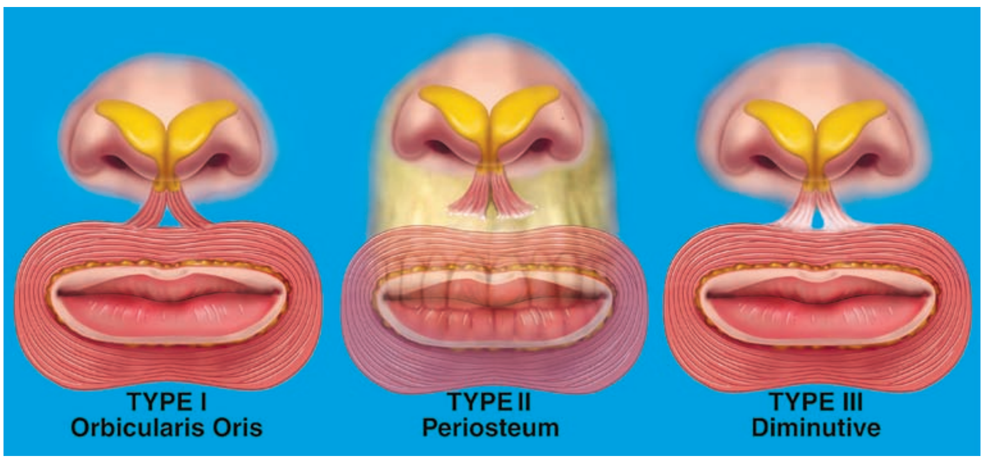
MUSCLES



The muscles of the nose are divided into an intrinsic group of seven paired muscles (having both origin and insertion within the perinasal area), and an extrinsic group containing three paired muscles.

The intrinsic group includes the procerus, which raises the dorsum and lowers the lateral cartilages. Its distal aponeurosis blends with the pars transversa of the nasalis muscle to form the superficial musculoaponeurotic system of the nose. The pars transversa provides lateral wall rigidity and can even be a dilatory muscle. In contrast, the pars alaris is the primary dilatory muscle of the ala and is responsible for alar flaring. The remaining nasal intrinsic muscles are of doubtful importance in nasal airway patency.

Of the extrinsic muscles, the levator labii superioris alaeque nasi is the most important dilator. The zygomaticus minor and orbicularis oris secondarily provide lateral wall stability. When clinically significant, the depressor septi nasi muscle may accentuate drooping of the nasal tip and shortening of the upper lip on animation.



We performed a cadaver study to define the anatomic variations of the depressor septi nasi muscle.[10] Three types of depressor septi nasi muscles were identified. Type I muscles (62%) are visible and identifiable, and can be traced to full interdigitation with the orbicularis oris from their origin at the medial crural footplate. Type II muscles (22%) are visible and identifiable, but unlike the first group, they insert into the periosteum and demonstrate little or no interdigitation with the orbicularis oris. In type III muscles (16%), no or only rudimentary depressor septi nasi muscles are visible.

More recently, anatomic studies have demonstrated a complex and dynamic relationship between muscles spanning between the nasal base and upper lip and cheek.[11] Their exact contribution to dynamic changes of the nose observed with facial expression and functional effects on the external valve have yet to be elucidated.

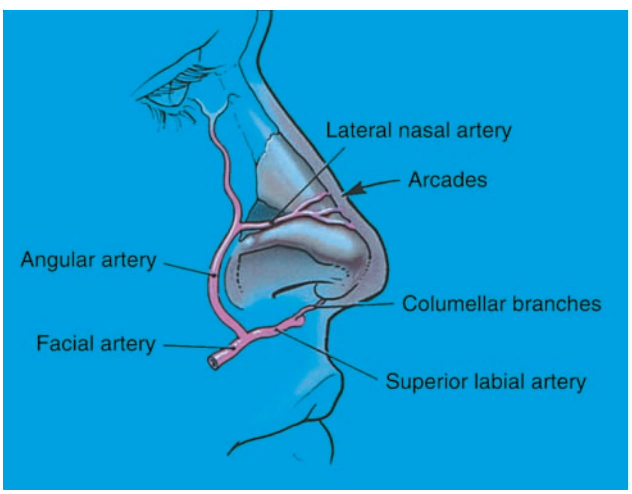
Clinical Applications

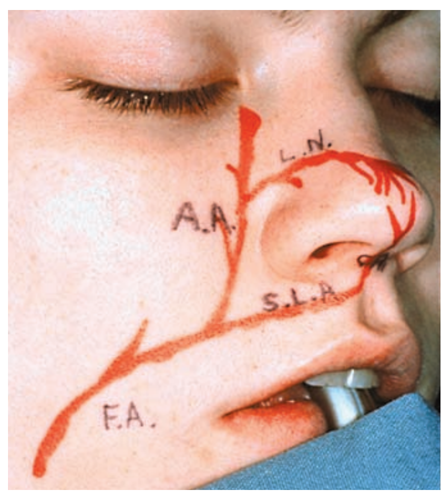
Routine preoperative examination of the rhinoplasty patient should easily identify those patients who demonstrate a drooping nasal tip and shortened upper lip on animation, particularly when smiling. In such patients (types I and II depressor septi nasi muscles), the attachments of the depressor septi nasi muscles can be disinserted from the medial crural footplates and caudal septum through the nasal incisions. If more lengthening of the upper lip is desired, through an upper gingivobuccal sulcus incision, dissection and transposition of the distal depressor septi nasi muscles and suturing together of the cut ends reliably and effectively correct this dynamic facial deformity. Dissection and transposition rather than excision of tissue provide fullness to the central upper lip, enhancement of the tip-lip relationship, relative upper lip lengthening, and maintenance of tip position with animation.

An active depressor septi nasi muscle can be identified on preoperative clinical analysis, and its modification intraoperatively can enhance the tip-lip complex.

BLOOD SUPPLY

Arterial





The arterial supply to the nose derives from two main arterial systems: the ophthalmic artery and the facial artery. The main artery of the ophthalmic system is the dorsal nasal artery (also known as the anterior ethmoidal or terminal branch of the ophthalmic artery), which emerges from the medial orbit and courses over the anterior surface of the nasal bones toward the nasal tip. The dorsal nasal artery supplies the cranial portion of the nose and contributes to the subdermal plexus of the nasal tip.

The nasal tip area is supplied primarily by the angular and the superior labial arteries, which are derived from the facial artery. In general, the angular artery provides the lateral nasal artery, which passes medially along the cephalic margin of the lateral crura and gives off caudal branches toward the nostril rim. The superior labial artery originates from the columellar artery, which courses up the columella to the region between the domes. The lateral nasal and columellar arteries then meet over the dorsal region, forming an alar arcade that runs along the cephalic margin of the lateral crura. This arcade runs superficial to the musculoaponeurotic layer.[7,12]

Superficial to the alar arcade is the subdermal plexus of the nasal tip skin that is supplied by branches of both ophthalmic and facial artery systems.

Venous

The venous drainage system also runs superficial to the musculoaponeurotic layer along the lateral wall, dorsum, and supratip regions of the nose. Although the anatomy of these veins is variable, most vessels drain into the facial vein inferiorly and/or the angular vein as it courses toward the medial orbit. One of the most important veins in the nose is the lateral nasal vein, which runs over the perichondrium of the middle nasal vault. Finally, there are no significant veins in the columellar region.

Lymphatic Drainage

Previous anatomic studies have demonstrated that the lymphatic drainage system is also located superficial to the musculoaponeurotic layer. Drainage occurs

dynamically along the lateral aspect of the nose, cephalad to the lateral crus, toward the piriform aperture and parotid lymph nodes. Lymphatic drainage does not occur in the columellar region.[7]

Clinical Applications

There has been concern, especially with the growing popularity of the open approach to rhinoplasty, that the transcolumellar incision may compromise nasal tip blood supply. However, the most recent anatomic studies have demonstrated the safety of this procedure.[8] Before flap elevation, only the columellar arteries are divided by the transcolumellar incision; adequate blood supply to the tip will derive primarily from the lateral nasal arteries and will be available as long as they are preserved during the procedure. However, caution is advised if the alar base has been previously excised. If the alar base incisions extend more than 2 mm superior to the alar groove, the lateral nasal arteries can be damaged bilaterally. These studies have also shown that defatting may jeopardize the nasal tip supply. In nasal tip procedures, the surgeon should reconstruct the underlying framework to redefine the tip instead of employing defatting techniques.

When the open approach is used, alar base excisions that extend more than 2 mm superior to the alar groove and defatting the nasal tip should be avoided to prevent vascular compromise of the nasal tip.

Surgical disruption of the venous and lymphatic vessels that run above the musculoaponeurotic layer of the nasal tip results in increased supratip edema. Therefore dissection of the nasal skin flap during rhinoplasty should be limited to the deep areolar tissue plane just above the cartilage and bone, leaving the musculoaponeurotic layer intact. This preserves the major arterial, venous, and lymphatic vasculature supplying the nose, which runs superficial to or within the musculoaponeurotic layer. Preservation of the vasculature ensures tissue viability and more rapid resolution of the tissue edema that occurs postoperatively.

Dissection in the deep areolar plane will not ensure preservation of the lateral nasal veins that pass over the perichondrium of the middle nasal vault. Although there are usually multiple veins draining the nasal tip, division of the lateral nasal veins may result in an increase in supratip edema. Therefore blunt dissection of the soft tissue overlying the middle vault is recommended to preserve these vessels, in an attempt to maximize venous return and help minimize tip edema.

NASAL VAULTS

The nose possesses three vaults: bony, upper cartilaginous, and lower cartilaginous vaults.[13]

Bony Vault

The bony vault is the principal structural base for the nose. It is generally pyramidal in shape and composes one third of the external nose. Consisting of the paired nasal bones and the ascending frontal process of the maxilla, the vault acts as a cantilever, supporting the upper nose and the upper lateral cartilages. The maxillary processes extend in a cephalad direction from the piriform aperture to the lacrimal crest, uniting with the frontal and nasal bones. The nasal bones articulate with each other medially, the frontal bone superiorly, the maxilla laterally, the perpendicular plate of the ethmoid posteriorly, and the upper lateral cartilages inferiorly.

The nasal bones average 2.5 cm in length, are much thicker and denser above the level of the medial canthus at the radix, and thin progressively toward the tip. They are also widest at the nasofrontal suture, narrowest at the nasofrontal angle, and tend to widen again inferior to the radix before narrowing near their inferior

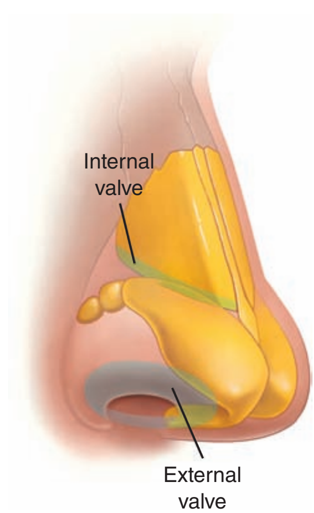
margin. A transition zone of bony thickness exists along the frontal processes of the maxilla from the piriform aperture to the radix along the lateral nasal wall. The bone in this region is less than 2.5 mm thick.

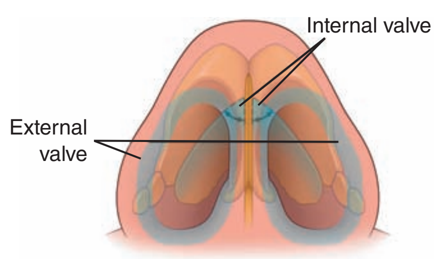
Clinical Applications

Osteotomies may be performed to narrow or widen the nasal base, repair an open-roof deformity after dorsal hump resection, and correct symmetrical or asymmetrical bone deformities. Reliable and predictable osteotomies may be executed at the transition zone of relatively thin bone along the frontal processes of the maxilla, from the piriform aperture to the radix along the lateral nasal wall. Osteotomies are rarely indicated superior to the level of the medial canthi, because this area is quite narrow and has thick bone.[14-16]

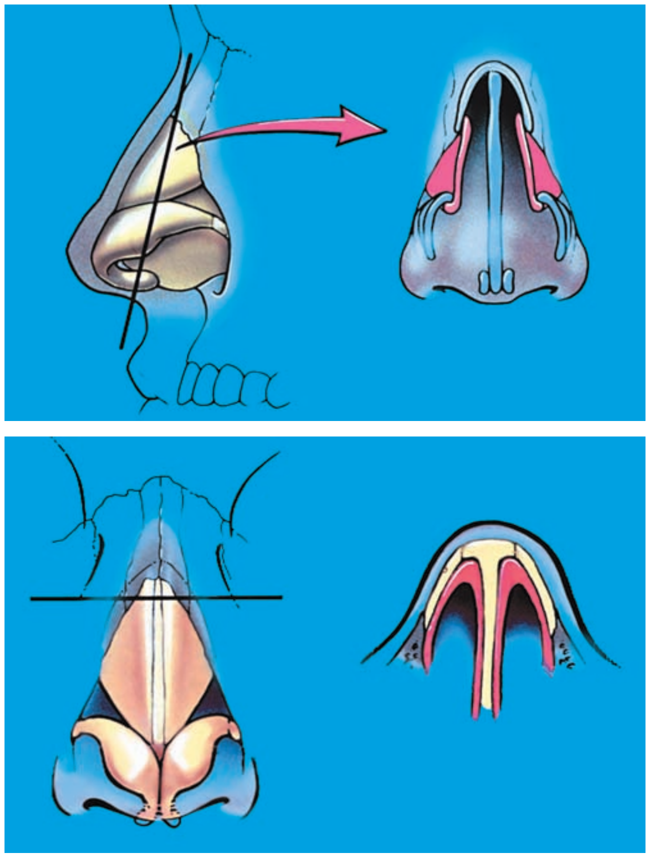
Osteotomies may be contraindicated in some patients with short nasal bones (distal border 1 cm beneath the intercanthal line) and in certain nonwhite races with extremely low and broad noses because of the risk of middle vault collapse and the associated functional airway compromise. In elderly patients with excessively thin nasal bones, patients with heavy glasses, and patients with thick skin over the dorsum, caution should be exercised if an osteotomy is considered.

Upper Cartilaginous Vault



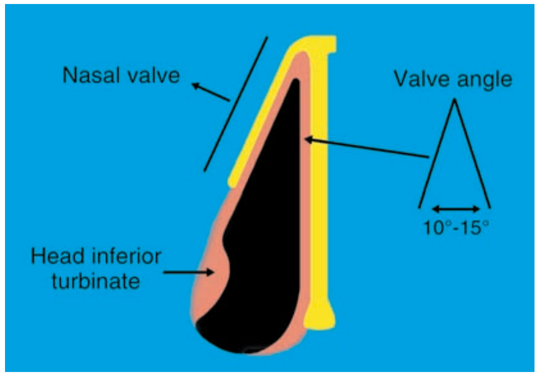


An important component of the upper cartilaginous vault is the internal nasal valve, which is bordered by the septum medially, the nasal floor inferiorly, the inferior turbinate laterally, and the caudal border of the upper lateral cartilage superiorly.

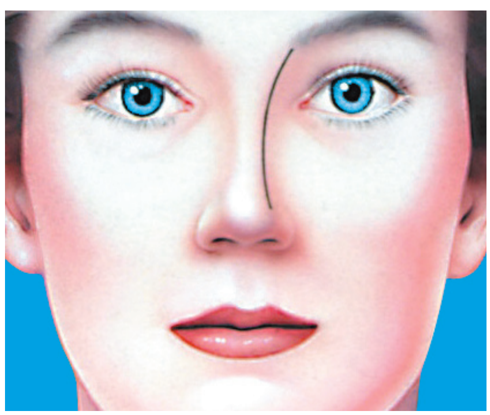


The junction of the upper lateral cartilages with the nasal bones and the septum defines the keystone area. The dorsal edge of the septum has a T-shaped contour in this region. The nasal bones actually overlap the cephalic edge of the upper lateral cartilages by 6 to 8 mm, thus producing a firm adherence between both structures, enhancing support. The angle between the septum and upper lateral cartilage is normally 10 to 15 degrees. Caudally the junction of the upper lateral cartilages with the cephalic edge of the lateral crus defines the scroll area. Most patients have some overlap of the lateral crura over the caudal edge of the upper lateral cartilages, which may enhance support at this level.

Clinical Applications



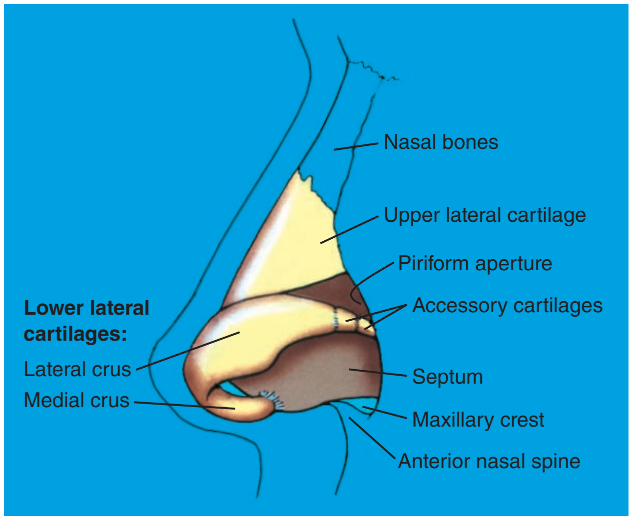
Previous studies have indicated that the nasal valves contribute much more to obstruction than previously realized and that the septum may play a much smaller overall role.[17,18] Therefore injury and/or destabilization of the keystone area during rhinoplasty must be avoided at all costs, because deformation of the normal 10- to 15-degree angle between the upper lateral cartilages and the septum will result in impaired airflow through the internal valve.[19] For example, scarring in the internal valve region resulting from violation of the mucosal lining during dorsal hump reduction or extension of an intercartilaginous incision to a transfixion incision will lead to obstruction of airflow through this critical area.

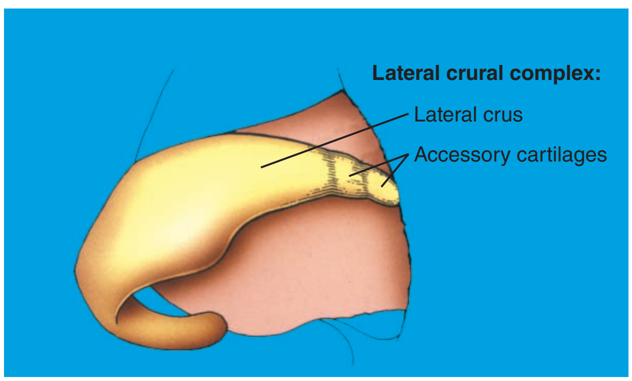


Dorsal reductions should be performed using an incremental component dorsal hump reduction technique, which allows preservation of the upper lateral cartilages. The upper lateral cartilages can then be manipulated independent of the dorsal septum, allowing greater control and decreasing the risk of overresection. This will tend to preserve the internal valve, avoiding disruption of the dorsal aesthetic lines, an inverted-V deformity, and airway compromise. In secondary rhinoplasty patients with these deformities, grafting, osteotomy, and suture techniques may be used to increase the cross-sectional area of the internal valve, improving the functional and aesthetic status of the nose.

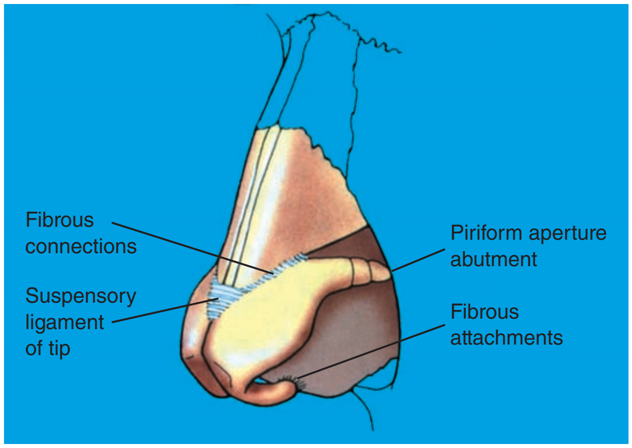
Lower Cartilaginous Vault

The external nasal valve exists at the level of the inner nostril. It is formed by the caudal edge of the lateral crus of the lower lateral cartilage, the soft tissue alae, the membranous septum, and the sill of the nostril.



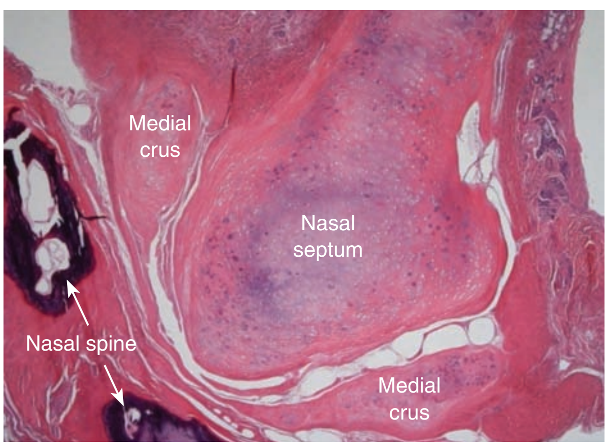


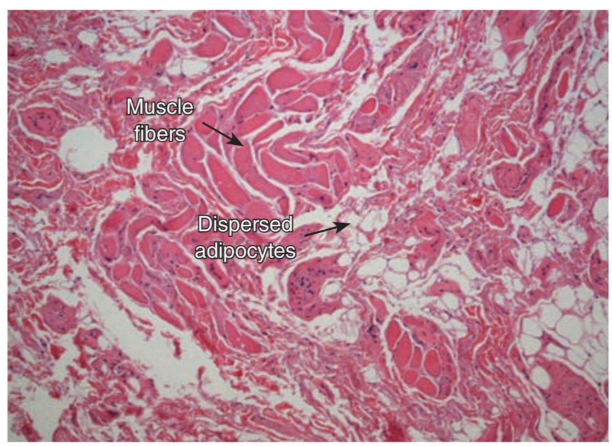
The framework of the nasal tip is formed by the medial, middle, and lateral crura of the lower lateral cartilages. Additionally, the accessory cartilages connect each lateral crus to the piriform aperture. All of these cartilages are bound together by a continuous perichondrium, which gives stability to the cartilages and causes them to act as a single structural and functional unit. This unit will be referred to as the lateral crural complex. The shape and position of this unit, the thickness of the overlying skin, and the fibrous attachments to the adjacent anatomic structures are interrelated and determine the appearance of the tip.[2,5,20-23]



The lateral crural complexes are supported by the suspensory ligament of the tip, the ligamentous connection between the cephalic margins of the lower lateral crura as they diverge from each other in the supratip area, and rest on the septal angle as well as the fibrous connections to the upper lateral cartilages, and abutment with the piriform aperture. The medial crura are supported by their elastic fibrous attachments to the caudal septum, the soft tissue interposed between their feet and the premaxillary area.

The fibrous attachments of the lower lateral cartilages to the septal angle, upper lateral cartilages, piriform aperture, caudal septum, and premaxilla provide support and determine the position of the tip.





Recent studies of columellar anatomy show the complex anatomy of this area, and this likely influences nasal tip support.[11,24] Our histologic study of the soft tissue of this area revealed the presence of multiple tissue types, including collagen, elastin, muscle, and adipocytes between the medial crura, septum, and skin. The presence of these different tissue types may have significant clinical applications,

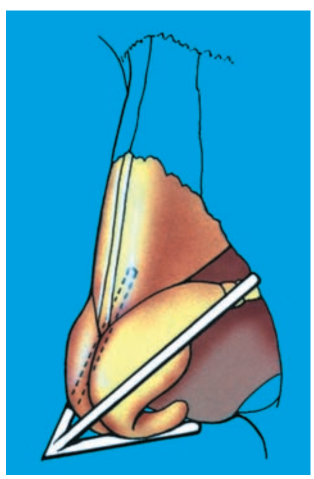
including understanding how certain surgical maneuvers affect tip projection, external valve function, the development of changes in the nose seen with age, and columellar aesthetics.

Clinical Applications

The external nasal valve is an occasional site of obstruction in rhinoplasty patients, particularly in secondary patients with a pinched alae deformity. This deformity may be caused by collapse of the lateral crura, which is generally caused by overresection of cartilage and injury to its supporting structures, facial nerve palsy, unstable lower lateral cartilages, and vestibular stenosis.

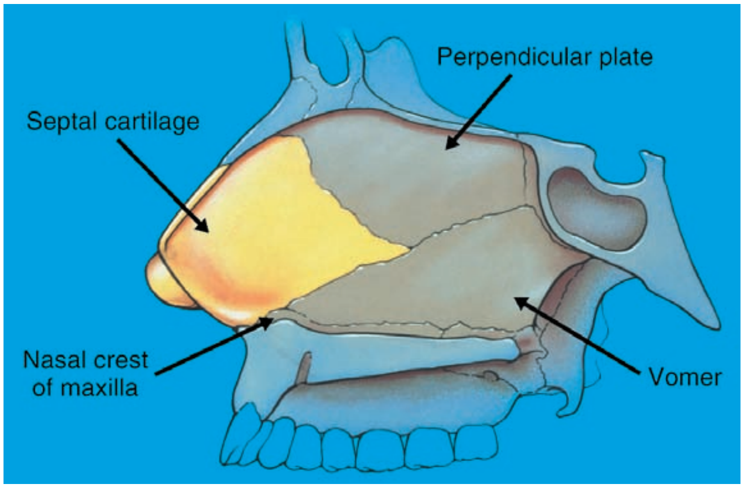
In rhinoplasty, numerous surgical techniques have been proposed to shape the tip cartilages. Common reasons for modifying these structures are to change tip projection, alter tip rotation, decrease the distance between the tip-defining points, reduce tip fullness, create a supratip break, and adjust the relationship between the columella and the alar rims.

Surgical maneuvers such as freeing the skin from the cartilages, transfixion incisions, cephalic trim, intercartilaginous incisions, and division of the lower lateral cartilages may disrupt the supporting system and change the position of these cartilages.

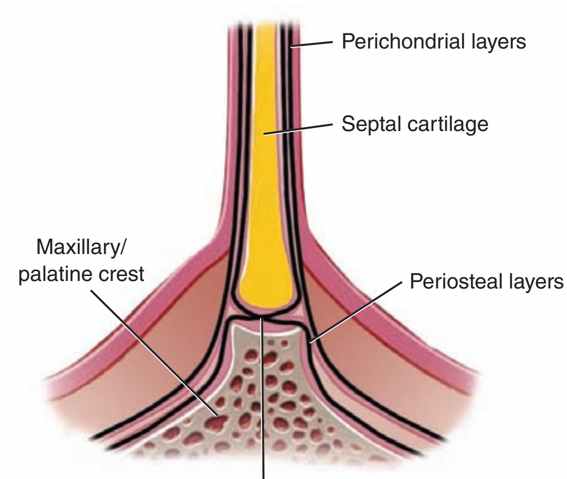


The cartilaginous framework of the tip has been described as a tripod. With the patient upright, the tripod lies on its side with one lower leg and two upper legs. The lower leg is represented by the medial crura, whereas each upper leg consists of a lateral crural complex based bilaterally on the piriform aperture. In theory, if the base of the tripod is fixed, reduction (by resection and closing dead space) or augmentation (by using grafts or struts) of the length of the legs should change variables such as projection and tip rotation.

INTERNAL NASAL ANATOMY: SEPTUM AND TURBINATES

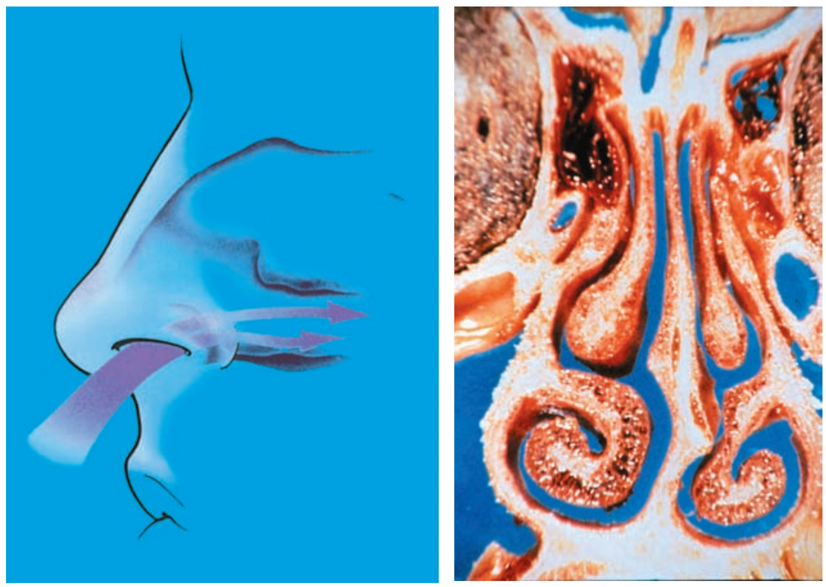


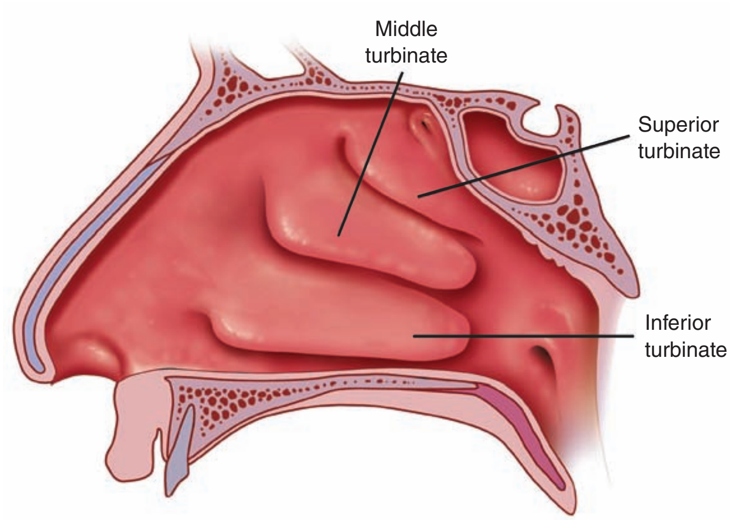
The central supporting system of the nose is the septal cartilage, which articulates posteriorly with the perpendicular plate of the ethmoid superiorly and the vomer inferiorly.[17,25,26] The vomer itself rests on the maxillary-palatine crests. The tongue-and-groove articulation between the quadrangular cartilage and the maxillary and palatine crest deserves special mention.



The perichondrium of the cartilage is only partially contiguous with the periosteum of the crests.[27] Other fibers pass through the articulation to join the contralateral perichondrium. This crossed configuration makes a contiguous submucoperichondrial dissection difficult at the osteocartilaginous junctions.

This same anatomic configuration also allows some movement between the crest and the septum, and it is this instability that explains the frequent posttraumatic findings of a displaced quadrangular septal cartilage from the groove of the crest. The anterior septum articulates caudally with the anterior nasal spine.





Parasagittal view of lateral nasal wall

The inferior turbinates are a key functional component in nasal airway breathing, because their anterior heads occupy a significant portion of the nasal passage. They are composed of dense lamellar bone originating from the medial maxillae and are covered with erectile mucosal tissue. This tissue is under autonomic control, and chronic inflammation can lead to fibrous deposition and chronic hypertrophy of the turbinate soft tissues and/or bone.

Clinical Applications

Autologous septal cartilage is a valuable commodity, with many indicated uses in plastic surgery. In fact, it is the preferred material for numerous grafts in modern rhinoplasty. When harvesting these grafts, an intact L-strut must be maintained for support. The width of the dorsal and caudal aspects of the L-strut will depend on the quality of the septal cartilage. With thick, strong cartilage, a minimum of 8 to 10 mm may be enough to ensure long-term stability. More commonly, the L-strut should be approximately 15 mm wide.

Aesthetic shaping of the septum may be performed to sculpt the nasal dorsum, help adjust the projection and rotation of the nasal tip, and improve the alar-columellar relationship.

The septum may play a less important role as a primary cause of nasal airway obstruction. In fact, not all deviated septa need correction, because it is common to have an asymptomatic septal deviation. When deviation occurs anteriorly and inferiorly (that is, in the area of the internal nasal valve), it is more likely to be a source of obstruction as a result of the smaller cross-sectional area of the airway in this region. Portions of the septum causing airway obstruction should be repositioned to the midline or removed. However, cartilage preservation should always be prioritized.

When harvesting septal cartilage and/or removing posterior septal deviations, it is important to perform a gentle sidewise fracture of the bony part of the perpendicular plate of the ethmoid, which is in continuity with the cribriform plate. These fractured bony fragments should be easy to remove. Otherwise, any remaining bony or soft tissue attachments should be completely detached. This avoids injury to the cribriform plate and the resulting cerebrospinal fluid rhinorrhea.

Enlarged turbinates may cause and/or contribute to airway compromise in some patients. Numerous treatment options have been proposed in the literature to reduce the mass of the turbinates and therefore improve the passage of air through the internal valve. In general, more limited approaches to turbinoplasty should be performed, because complete turbinectomy may put the patient at increased risk for developing atrophic rhinitis postoperatively.

The dorsal septum has a T geometry in cross-section. Techniques such as component dorsal hump reduction, spreader grafts, and flaps for both functional and aesthetic reasons aim to preserve or recreate this anatomy.

KEY POINTS

- Excellent rhinoplasty results can only be obtained if the surgeon has a thorough knowledge of nasal anatomy and a grasp of the surgical relevance of alteration of the anatomic structures.
- The type, texture, and sebaceous content of the skin must be carefully analyzed, because it will influence the approach for modifying the framework and therefore the final result.
- An active depressor septi nasi muscle can be identified on preoperative clinical analysis, and its modification intraoperatively can enhance the tip-lip relationship.
- When the open approach is used, alar base excisions that extend more than 2 mm superior to the alar groove and defatting the nasal tip should be avoided to prevent vascular compromise of the nasal tip.
- The fibrous attachments of the lower lateral cartilages to the septal angle, upper lateral cartilages, piriform aperture, caudal septum, and premaxilla provide support and determine the position of the tip.

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3

Nasal Physiology

Michael R. Lee ▪ Rod J. Rohrich ▪ Jamil Ahmad

A thorough understanding of nasal physiology is essential to provide optimal results in rhinoplasty. Although achieving aesthetic improvement is often the focus of surgery, nasal function is of equal and, occasionally, primary importance. Surgeons should understand the basic functions of the nose and its internal structures. An intimate relationship exists between the anatomy of the nose and its associated functions. An understanding of normal physiology and the aberrations that occur in disease states enable the surgeon to provide a comprehensive approach to treatment. When this understanding guides surgical planning and execution, existing deformities are corrected and untoward functional consequences can be avoided.

There is an intimate relationship between the anatomy of the nose and its associated physiology. An understanding of this relationship provides the basis for both nasal analysis and treatment planning.

Approximately half of the total airway resistance occurs in the nasal cavity, underscoring its significant role in the regulation of airflow through the respiratory tract.[1] However, nasal function extends beyond the role of the nose as a simple conduit. Inspired air is filtered, humidified, and warmed in preparation for continued passage toward the nasopharynx. The nose also contributes to such functions as smell and phonation.

The nasal airway is responsible for 50% of overall airway resistance, underscoring its importance in nasal airflow

Nasal physiology is influenced by the external and internal structures of the nose. Nasal structures can be conceptually divided into the bony and cartilaginous framework and the nasal mucosa and soft tissues. These two components work in concert to provide optimal function of the nose and nasal cavity. Surgeons should be aware of the interplay between these two components, because both are crucial to properly addressing nasal dysfunction.

Mucosal disease is infrequently cured with surgical manipulation alone and often requires medical management. Improvement in mucosal disease may occur if the condition is caused by underlying anatomic deformities that are addressed during surgery. With normal mucosal behavior and isolated anatomic deformities, surgery should result in an improvement in nasal airflow.

Nasal airway obstruction may have a structural and/or functional cause, and accurate diagnosis will guide appropriate treatment planning.

NASAL FUNCTION

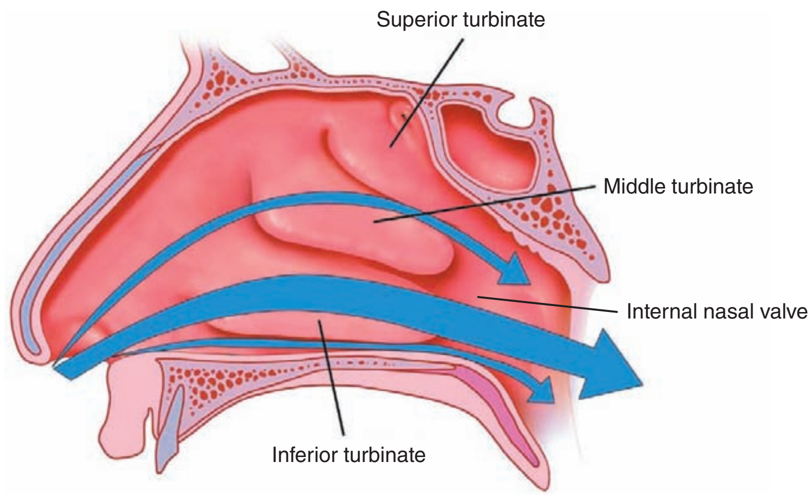
The primary function of the nose is to provide a passageway for external air to be transported to the pulmonary system for blood oxygenation. Despite the relatively short length of the nasal cavity compared with the length of the remaining airway, approximately half of total airway resistance occurs within the nose. Airflow patterns through the nose and upper airway are well understood, since they follow basic physical laws.

In addition to respiration, the nose and nasal cavity perform an additional six functions: particle filtration, air humidification, temperature modification, olfaction, phonation, and chemoreception.

Respiration

External air is transported into and through the nasal cavity by a generated pressure differential. The negative intranasal pressure generated during inspiration allows air movement and is influenced by the velocity of airflow and resistance

along the nasal cavity. Initiation of inspiration is associated with nostril enlargement to accommodate the influx of external air into the nose and through the external nasal valve.[2] Inspired air continues through the nasal cavity in a parabolic curve pattern following this pressure gradient.[1] Most of the air continues over the inferior turbinate, passing through the middle meatus; the greatest resistance occurs at the internal nasal valve.[3,4]



Most of the air continues over the inferior turbinate, passing through the middle meatus; the greatest resistance occurs at the internal nasal valve.

Approximation of the caudal upper lateral cartilage and nasal septum creates an angle at the internal nasal valve. This anatomic location is frequently susceptible to collapse from negative pressure generated at the beginning of inspiration. Expiration has the converse effect as the internal nasal valve is enlarged and nostril size becomes smaller.

Airflow may be described as *laminar* or *turbulent*.[1] Laminar flow is organized and predictable, following a straight pattern. Such a flow pattern exhibits high efficiency, with centrally rapidly moving particles flanked by more stagnant peripheral particle movement. Conversely, turbulent flow is less predictable and follows a more random pattern. Such flow is the result of disrupted laminar flow and requires an increased pressure gradient to correct. Turbulent flow is composed of whorls and eddies that allow increased particle contact with mucosal surfaces. Because the nasal cavity is not a tubular structure, nasal airflow is not truly laminar in nature. Instead, the parabolic curve pattern of airflow is another mechanism that contributes to turbulent airflow and increases resistance to airflow. At low pressures less than 1 cm of water, airflow approximates laminar flow.[5]

Thus quiet respiration tends to create a more laminar flow pattern, whereas more labored inspiration is associated with turbulent flow patterns.

Nasal airflow is best described using several basic physical laws. Air is introduced through both nostrils and directed into the nasal vestibule. The following formula relates nasal airflow with resistance at the level of the external nasal valve:

$$1/\text{Total resistance} = 1/\text{Left nostril resistance} + 1/\text{Right nostril resistance}$$

Inspired air may meet resistance at the external nasal valve before reaching the internal nasal valve. Obstruction or dysfunction of either nostril leads to an overall increase in nasal airway resistance. Airflow follows the path of least resistance. For example, air may be shunted in the case of an anterior septal perforation. By following the path of least resistance, a perforation allows the airflow from the more resistant side to redirect to the less resistant side, thus lowering total resistance.

Ohm's Law

Ohm's law has been used to describe fluid flow and states that flow is directly proportional to the difference in pressure (dP) and inversely proportional to the resistance[3]:

$$\text{Flow} = \text{dP}/\text{Resistance}$$

Ohm's law applied to nasal physiology stresses the importance of structural integrity and patency to accommodate airflow pressure gradients. The cartilaginous infrastructure must be sufficient to withstand the negative pressures generated during inspiration, or collapse will exacerbate obstructive symptoms during inspiration. Anatomic deformities that lead to increased resistance will decrease airflow. Thus increased pressure is required to generate airflow. This increased pressure may result in greater deformation of nasal structures leading to yet greater obstructive symptoms.

Bernoulli's Principle

Bernoulli's principle establishes that airflow is equal at opposing ends of a tube when the diameter is equivalent. A decrease in diameter leads to a lower pressure and increased velocity.[6] An example of this effect can be seen at the level of the nasal valves. If the internal nasal valve is restricted, velocity of airflow is increased, generating greater negative pressure. Greater negative pressure potentiates further internal valve collapse and may worsen obstructive symptoms.

Poiseuille's Law

Poiseuille's law states that flow through a tube is directly proportional to the difference in pressure (dP) multiplied by radius to the fourth power (r^4). Furthermore, flow is inversely proportional to the length of the tube[6]:

$$\text{Flow} = \text{Constant (K)} \times \text{dP} \times r^4/\text{Length}$$

The cross-sectional area is variable throughout the nasal airway. It is smallest at the level of the internal nasal valve, measuring 30 to 40 mm^2. Posterior to the internal nasal valve, there is much greater cross-sectional area and lower resistance to airflow. The internal nasal valve is a bottleneck to airflow in the nasal cavity and is commonly a site for nasal airway obstruction.[1,7-14]

The internal nasal valve is a bottleneck to airflow in the nasal cavity and is commonly a site for nasal airway obstruction.

Venturi Effect

The Venturi effect was initially applied as a law governing fluid dynamics; it relates to a reduction in pressure when flow increases through a constricted section of a tube. Again, this effect may be seen most at the narrowest segments of the nasal airway, including the internal nasal valve.

Particle Filtration

Particle filtration begins with air passage through the nasal vestibule. Nasal vibrissae in this location provide the initial mechanical barrier to larger particles. Particles that escape the vestibule can also become suspended in nasal air and are deposited on the nasal mucosal surfaces. Airway architecture, which is composed of curves and sharp deflections, allows improved deposition. Ninety percent of particulate matter greater than or equal to 5 microns in size is deposited primarily at the internal nasal valve and nasopharynx, where the airstream is changed from a column to a sheet. This method of filtration is termed *impingement*. The mucosal lining produces a bilayered mucous blanket with a thin deep layer and a thicker, more viscous superficial layer. The mucous blanket possesses an overall positive ionic charge. Negatively charged particulate matter becomes attached and is removed through mucociliary clearance. Cilia stemming from the deep layer beat at 1000 beats per minute and move the more viscous superficial layer. This mechanism allows movement of particulate matter toward the nasopharynx, along with drainage from the paranasal sinuses.

Air Humidification

Inspired air undergoes humidification as it passes through the nasal cavity. Such modification in air characteristics provides a moisturized environment, which is important for proper sinonasal function. Overall, the vast majority of air humidification occurs in the nasal airway compared with the remaining upper airway tract. At introduction into the alveoli, air is typically at 100% humidification.

The process of expiration results in the cooling of air. Since cool air possesses less moisture than warm air, a small volume of water is recovered during expiration; the net balance for human respiration is a water loss of 250 to 500 ml per day.

Temperature Regulation

In addition to humidification, air also undergoes temperature regulation in the nasal cavity. This process is closely related to air humidification. This allows inspired air to reach temperatures approximating that of core body temperature by the time the air reaches the larynx.

Olfaction

Olfaction is an important role of the nose and nasal cavity. Smell allows the body to obtain information about the external environment. Such information serves key roles in taste, memory, and even avoidance of potential danger. Patients with chronic conditions such as allergic rhinitis or rhinosinusitis may have partial or complete loss of olfaction. Olfaction may also be compromised by medications, trauma, mechanical obstruction, disorders of ciliary function, endocrine disorders, and congenital disorders such as Kallmann's syndrome (congenital hypogonadism with anosmia).

On inspiration, air particles contact olfactory epithelium, located primarily on the roof of the nasal cavity. Olfactory transduction occurs, converting odor molecules into electrical signals that are perceived as smells by the brain.

Phonation

Both the nasal cavity and paranasal sinuses contribute to resonance during phonation. Nasal consonants such as *m* and *n* require nasal airway patency. Nasal airway obstruction may result in hyponasality. When septal perforations are present, patients may create a whistling sound when breathing.

Chemoreception

In many animals, the anterior nasal septum houses the vomeronasal organ (Jacobson's organ). This organ occurs as bilateral paired blind ducts in the anterior septal mucosa.[15,16] Within the organ is specialized epithelium that may serve as pheromone chemoreceptors. The presence of these structures in humans continues to be debated.

THE NASAL CYCLE

The nasal cycle is a normal physiologic process of alternating mucosal constriction and dilation of each side of the nasal cavity. Approximately 80% of people experience this, and the nasal cycle can be affected by emotion, exertion, and external temperature. Total airflow and resistance remain constant throughout the process, which requires 30 minutes to 5 hours per cycle.[11] Although this is a normal physiologic process, many patients may be unaware of this before surgery and may confuse this process with postoperative nasal airway obstruction.

CLINICAL EVALUATION

Primary assessment of the nasal airway is accomplished through a focused history and physical examination. Relevant factors include the onset, timing, duration, and severity of symptoms. Exacerbating and alleviating factors should also be detailed, and any history of prior trauma or nasal surgery should be ascertained. Nasal airway obstruction that is constant suggests an anatomic problem, whereas fluctuating symptoms are more commonly associated with a physiologic cause. Symptoms of unilaterality, epistaxis, or a progressive worsening warrant exclusion of a neoplasm.

Physical examination should begin with evaluation of the external nose. The external nasal valve is assessed by observing the nasal base during quiet and forced inspiration. Collapse of the nostril, which may be unilateral or bilateral, suggests a weak lateral crus. Similarly, collapse of the lateral nasal wall may suggest weak upper lateral cartilage and possibly internal valve dysfunction. Dorsal nasal deviation or collapse suggests a septal cause, with the potential for internal valve dysfunction. Collapse of the nasal midvault may be seen in patients displaying an inverted-V deformity or distorted dorsal aesthetic lines.

Internal examination of the nose is of critical importance and is facilitated with a nasal speculum and proper lighting. The nasal cavity should be assessed at rest and during respiration. At rest, the septum can be assessed. Deviation, sep-

tal spurs, or perforation of the nasal septum should be noted. Crusting or dried blood may be a sign of an underlying pathologic condition. Turbinate status should also be investigated. Large, boggy turbinates with a bluish hue suggest allergic changes to the mucosa. Application of a topical nasal decongestant such as oxymetazoline can help distinguish between mucosal swelling and bony hypertrophy. If the turbinate responds with resolution of engorgement, then mucosal disease is the primary problem.

Mucosal disease is less responsive to surgical intervention compared with bony hypertrophy or malposition. Middle turbinates should also be assessed for the existence of concha bullosa. The internal nasal valve is evaluated both at rest and during respiration. The caudal border of the upper lateral cartilage can usually be seen as it adjoins the nasal septum. Collapse of the internal nasal valve suggests dysfunction. Other means of assessing the adequacy of the internal nasal valve include the Cottle test and the use of nasal strips.[17]

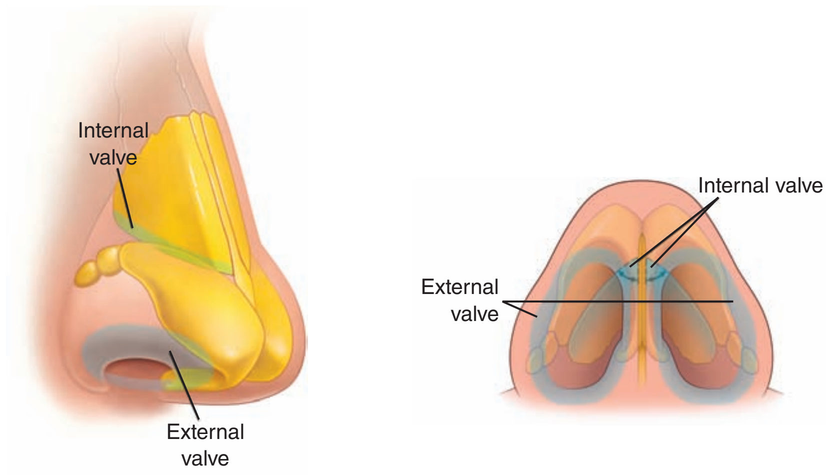
RELEVANT ANATOMY AND CLINICAL APPLICATIONS

The anatomy of the nose and nasal cavity influences nasal airflow. Structures including the external nasal valve, internal nasal valve, nasal septum, and turbinates and nasal mucosa are common sites of abnormalities contributing to nasal airway obstruction.

External Nasal Valve

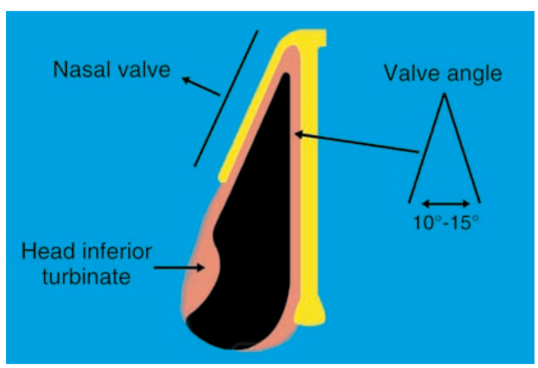
Nasal airflow begins with movement through the nostril and into the vestibule. The nasal vestibule houses the external nasal valve formed by the alar rim, nasal sill, caudal septum and medial crus. A weakened or malpositioned lateral crus can lead to external valve collapse and subsequent obstruction. The external nasal valve is responsible for approximately one third of total airway resistance.

If there is insufficient cartilaginous support, low pressures in the vestibule during inspiration can collapse the nostril and vestibule, increasing resistance and decreasing flow. This is frequently seen in secondary rhinoplasty patients in whom the lateral crura have been overresected or weakened by manipulation. Correcting deformities of the external nasal valve hinges on correcting the existing weakness of the lateral crus. If the lateral crus is weak, then cartilage grafts such as lateral crural strut grafts, alar batten grafts, or alar contour grafts may be required.



Alternatively, severe caudal septal deviation can decrease the cross-sectional area of the external valve and contribute to obstruction at this site. In addition to strengthening the lateral crus, midline repositioning of the caudal septum is of equal importance to reestablishing the structural integrity of the external nasal valve.

Internal Nasal Valve



Resistance to nasal inflow is greatest at the internal nasal valve, because this structure accounts for the majority of total airway resistance. As previously mentioned, the abutment of the caudal edge of the upper lateral cartilage with the dorsal septum creates the internal valve angle. Airflow through the internal nasal valve may be limited when the angle formed by the junction of the upper lateral cartilage and the nasal septum is less than the typical 10 to 15 degrees.[3,4] Additionally, the anterior head of the inferior turbinate forms the posterior border, and hypertrophy will also negatively effect nasal airflow at the internal nasal valve. When the inferior turbinates are a contributing factor, it must be determined whether bony hypertrophy or mucosal disease is the cause.

Airflow through the internal nasal valve may be limited when the angle formed by the junction of the upper lateral cartilage and the nasal septum is less than the typical 10 to 15 degrees.

Deviation of the dorsal septum can also compromise the internal nasal valve. This area must be addressed surgically to straighten the septum and restore the angle of the internal nasal valve. When the upper lateral cartilages lack the rigidity necessary to withstand inspiration pressure, there can be a dynamic collapse of the valve.

Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty. Disruption may occur during dorsal hump reduction emphasizing the importance of maintaining or rebuilding the internal valve. Patients with short nasal bones and long, poorly supported upper lateral cartilages are at highest risk.[8] Employing component dorsal hump reduction with upper lateral crura tension-spanning sutures maximizes preservation of the existing anatomy. Autospreader flaps also function to preserve or increase the internal nasal valve angle. Reconstructing the internal nasal valve is required in primary rhinoplasty when internal nasal valve dysfunction is present or if the internal nasal valve is not preserved during treatment of the dorsum.

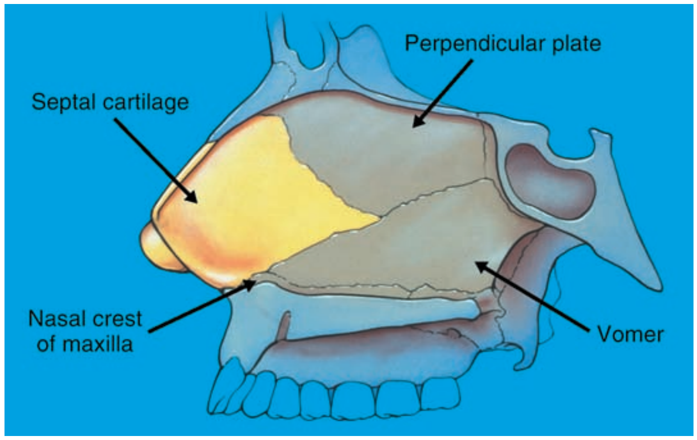
Secondary rhinoplasty more frequently requires reconstruction of the internal nasal valve when the midvault was not preserved or reconstructed during the previous nasal surgery. These patients may have an inverted-V deformity, lateral wall weakness, and/or distortion of the dorsal aesthetic lines.

Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty.

Nasal Septum

In addition to comprising the external or internal nasal valve, the septum may cause obstruction of airflow throughout the nasal cavity. Although deviation of the anterior cartilaginous or posterior bony septum may lead to nasal airway obstruction, the anterior septum tends to be more clinically relevant. The cross-sectional area of the posterior airway is much greater in comparison with that of the nasal valves of the anterior airway.

Furthermore, the septum provides overall support for the external nose. Seated on the nasal spine of the maxilla, the nasal septum serves as the scaffolding for



a mucosa and the upper and lower lateral cartilages. Anomalies of the septum such as deviations, spurs, and perforations may adversely affect nasal airflow. These changes may be developmental in nature and worsen over time, or septal abnormalities may occur as a result of trauma. Deviation of the septum may also influence turbinate size and mucosal behavior. Typically, the inferior turbinate on the side opposite the septal deviation will undergo mucosal and/or bony hypertrophy.[1,18]

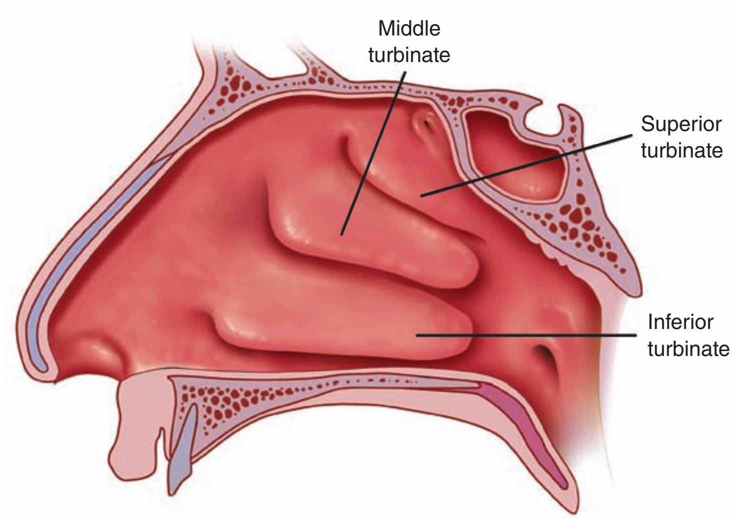
Surgical correction of the septum in general may be accomplished through septoplasty or septal reconstruction. Septal reconstruction involves midline repositioning of the septum or resection of deviated portions or spurs.

Septal perforations may be asymptomatic or can cause problems ranging from a whistling sound during respiration to chronic bleeding, crusting, and malodor. Repair of septal perforations may be achieved using local mucosal flaps or the placement of interposition grafts, such as temporal fascia.

Turbinates and Nasal Mucosa

Nasal turbinates are paired extensions of the lateral nasal wall; they increase overall mucosal surface area. Turbinates contribute a significant role in air transport and conditioning as well as olfaction. The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve. However, the middle turbinates may also contribute to nasal airway obstruction.

The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve.



Parasagittal view of lateral nasal wall

Composition of septal and turbinate mucosa includes erectile tissue with capacitance vessels responsible for volume changes. The dynamic nature of mucosal tissue is essential to normal nasal function. Regulation occurs by expansion (congestion) or contraction (decongestion). Blood supply distributed to the erectile tissue is responsible for expansion or contraction and is regulated by the autonomic nervous system. Nasal mucosa is also influenced by such nonanatomic factors as stress and emotion, external temperature, allergies, inflammatory conditions, infection, smoking, medications, trauma, pregnancy, and the aging process.

Differentiating between mucosal disease and bony hypertrophy will help the surgeon formulate the appropriate treatment plan. Surgical maneuvers such as inferior turbinate outfracture or submucosal resection will help to lateralize or decrease turbinate volume, respectively.[18,19] Mucosal hypertrophy resulting from rhinitis may be better managed medically.

KEY POINTS

- There is an intimate relationship between the anatomy of the nose and its associated physiology. An understanding of this relationship provides the basis for both nasal analysis and treatment planning.
- The nasal airway is responsible for 50% of overall airway resistance underscoring its importance in nasal airflow.
- Nasal airway obstruction may have a structural and/or functional cause, and accurate diagnosis will guide appropriate treatment planning.
- In addition to respiration, the nose and nasal cavity perform an additional six functions: particle filtration, air humidification, temperature modification, olfaction, phonation, and chemoreception.

- Most of the air continues over the inferior turbinate, passing through the middle meatus; the greatest resistance occurs at the internal nasal valve.
- The internal nasal valve is a bottleneck to airflow in the nasal cavity and is commonly a site for nasal airway obstruction.
- Airflow through the internal nasal valve may be limited when the angle formed by the junction of the upper lateral cartilage and the nasal septum is less than the typical 10 to 15 degrees.
- Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty.
- The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve.

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4

Medical Management of Rhinologic Disorders in the Rhinoplasty Patient

C. Spencer Cochran ▪ Bradley F. Marple

Although some patients undergo rhinoplasty for cosmetic reasons, many patients seek initial surgical evaluation for correction of functional problems with the nose, such as nasal obstruction or congestion. The nose performs six key functions of the upper airway: respiration, olfaction, humidification, temperature modification, particle filtration, and phonation.[1] Any of these nasal functions can be altered or impaired by structural or functional abnormalities arising from sinonasal disease processes, and functions that are affected by mucosal disease are particularly important to the rhinoplasty surgeon.

A thorough understanding of nasal function and the impact of rhinologic disease processes is crucial to the overall success of the rhinoplasty surgeon.

Nasal Disorders	
Inflammatory Disorders	**Noninflammatory Disorders**
Acute rhinosinusitis	Atrophic rhinitis
Adenoid hypertrophy	Nonallergic rhinitis
Allergic fungal rhinosinusitis	Rhinitis medicamentosa
Allergic rhinitis	Vasomotor rhinitis
Chronic rhinosinusitis	**Other or Systemic Disorders**
Deviated septum	Cocaine-induced destructive lesions
Internal/external valve collapse	Sarcoidosis
Nasal polyposis	Wegner's granulomatosis
Structural abnormalities	
Turbinate hypertrophy	

INFLAMMATORY DISORDERS OF THE NOSE AND PARANASAL SINUSES

The nasal mucosa and its mucociliary blanket act as the initial barrier to infection and environmental insult. Thus the intranasal mucosa and paranasal sinuses are frequent sites of both allergic and nonallergic inflammation. Nasal mucus is a complex aqueous mixture of glycoproteins, lipids, salts, and other cellular constituents that normally protects nasal epithelia. Aside from its function as a simple mechanical barrier, nasal mucus likely plays an active role through inactivation of many substances that gain access to the nose.[2] Understanding the underlying pathophysiology of the inflammatory disorders can improve the selection of treatments of these conditions and their impact on rhinoplasty patients and outcomes.

Allergic Rhinitis

Allergic rhinitis has been estimated to affect 40 million Americans, with health care–related expenditures in the billions of dollars.[3] Allergic rhinitis is a type I allergic reaction in which allergen-specific immunoglobulin E (IgE) bound to nasal mast cells interacts with an inhalant allergen to produce the following symptoms of allergic rhinitis: sneezing, pruritus, congestion, rhinorrhea, and nasal discharge. Although allergic rhinitis is still only partially understood, key elements of its pathophysiology have been elucidated. Initially, an individual who is susceptible to the development of allergic disease encounters a potential allergen. *Sensitization* is the process in which the immune system is triggered to recognize an allergen, ultimately leading to the development of T-lymphocytes, B-lymphocytes, and allergen-specific IgE. On subsequent exposures, the same allergen can simultaneously bind to two adjacent allergen-specific IgE molecules on the surface of a mast cell, triggering degranulation of the cell and release of histamine and other inflammatory mediators.[4] This reaction is referred to as the *early phase response* and leads to the immediate onset of symptoms, such as sneezing, rhinorrhea, and congestion. This process, in turn, leads to further recruitment of neutrophils, lymphocytes, and eosinophils. Once at the site of the initial degranulation of the mast cell, these inflammatory cells give rise to a self-sustaining inflammatory reaction known as the *late phase response,* which is less severe but more prolonged than the early phase response.[3]

Treatment of allergic rhinitis begins with identification of and avoidance of the allergen, which precludes the formation of antigen-specific IgE and eliminates the initiation point of the allergic cascade. In reality, avoidance is difficult to achieve,

Pharmacologic Agents for Allergic Rhinitis

Target Therapy	**Immunomodulation**
Anticholinergics	Immunotherapy
Antihistamines	Intranasal steroids
Antileukotrienes	Systemic steroids
Decongestants	
Mast cell stabilizers	
Mucolytic	

and patients must rely on medical management to treat their allergy symptoms. Medical management of allergic rhinitis involves both target therapy and immunomodulation. Targeted forms of therapy (antihistamines, decongestants, mucolytics, anticholinergics, antileukotrienes, and mast cell stabilizers) address the mediator effects of allergy, whereas immunomodulation (topical or systemic steroids, immunotherapy, and potentially monoclonal antibodies) prevents initiation and downregulates the allergic response.

Allergy may present as a single rhinologic disease, or it may coexist with or contribute to other rhinologic disease processes. For example, allergy produces mucosal edema, which may lead to sinusitis via ostial obstruction and set the stage for secondary bacterial infection.[5]

Allergic rhinitis may present as a single rhinologic disease, or it may coexist with or contribute to other rhinologic disease processes.

Acute Rhinosinusitis

Acute rhinosinusitis (ARS) is an inflammatory state involving the paranasal sinuses and intranasal mucosa. It is defined as a discrete infectious process that lasts less than 4 weeks.[6] The diagnosis of ARS is established by a strong history of two or more major factors, one major factor plus two minor factors, or nasal purulence on examination.[7] Allergy, structural abnormalities, cystic fibrosis, cilia defects, viral or bacterial infections, and immunosuppression can contribute to the development of ARS. Antibiotics and decongestants are the mainstays of treatment for bacterial ARS.

Acute Rhinosinusitis: Diagnostic Criteria

Major Criteria	**Minor Criteria**
Facial pain/pressure	Headache
Fever	Dental pain
Hyposmia/anosmia	Fatigue
Nasal discharge	Fever
Nasal obstruction	Halitosis
Purulence in nasal cavity	Otalgia/pressure/fullness

Rhinoplasty is generally contraindicated in the presence of active infection.

Chronic Rhinosinusitis

Chronic rhinosinusitis (CRS), an inflammatory state differing in duration from ARS, was formally defined in 2002 by the Task Force for Defining Chronic Rhinosinusitis as a "group of disorders characterized by inflammation of the mucosa of the nose and paranasal sinuses of at least 12 weeks' duration."[7] Although infection certainly may represent a component of CRS, it is becoming increasingly clear that there is a multifactorial causation and interrelationship among many of the inflammatory disorders of the nose and paranasal sinuses.[8] Treatment of CRS is medical, with functional endoscopic sinus surgery (FESS) reserved for treatment failures. Several studies indicate that sinus surgery at the time of rhinoplasty may be a viable option if there are no signs of infection.[9]

Allergic Fungal Rhinosinusitis

Allergic fungal rhinosinusitis (AFS) is an immunologically mediated sinonasal disease process rather than an infectious process. The inflammation associated with AFS is probably related to eosinophil chemotaxis and degranulation. The diagnosis of AFS is established by the characteristics of IgE-mediated hypersensitivity, nasal polyposis, characteristic CT or MRI findings, allergic fungal mucin, and positive fungal stain of sinonasal contents. Long-term control of allergic fungal sinusitis requires both elimination of fungal antigen (usually requiring surgery) and control of its recurrence through either immunomodulation (immunotherapy or corticosteroids) or fungistatic antimicrobials.[10]

Nasal Polyposis

Nasal polyposis is the end result of intranasal inflammation and may present as an isolated phenomenon, referred to as *idiopathic nasal polyposis,* or as a component of other rhinologic diseases such as allergic fungal sinusitis. *Samter's triad* refers to nasal polyposis in addition to asthma and allergy or sensitivity to aspirin. *Inflammatory nasal polyposis* is usually a bilateral disease and when unilateral may signify a neoplastic process.

Treatment of nasal polyposis entails administration of antileukotrienes, topical steroids, systemic corticosteroids, and often debulking in a functional endoscopic sinus surgical procedure. Although steroid nasal sprays are effective for the treatment of small nasal polyps and prevention of polyp regrowth after nasal and sinus surgery, large polyp masses that essentially block the nasal passage will not generally yield to topical therapy.

NONINFLAMMATORY RHINOLOGIC DISORDERS

Rhinitis Medicamentosa

Rhinitis medicamentosa refers to rebound rhinitis and congestion of the nasal mucosa resulting from the sudden cessation of topical decongestants after prolonged use. Treatment is supportive and entails absolute abstinence from further topical decongestants. Topical steroid sprays and even systemic steroids may be beneficial to attenuate the mucosal hyperemia and edema.

Postrhinoplasty Rhinitis

After rhinoplasty, some patients complain of nasal obstruction. Beekhuis[11] reported a 10% incidence of symptomatic nasal obstruction in his series of rhinoplasty patients. Treatment is often expectant, but oral decongestants, topical nasal steroid sprays, and nasal saline irrigation may be of use.

Atrophic Rhinitis

Overresection of intranasal structures such as the middle or inferior turbinate can lead to atrophy of the nasal mucosa with subsequent symptoms of dryness, crusting, and nasal obstruction. Nasal saline solution may provide symptomatic relief.

PHARMACOLOGIC AGENTS

Antihistamines

The histamine that is released from mast cells in the allergic response causes vasodilation and an increase in vascular permeability. Early phase reactions to histamine produce symptoms such as sneezing, rhinorrhea, and congestion. Late phase reactions include eosinophil recruitment, cellular adhesion, and leukotriene effects.

Antihistamines are agents that have been developed to block the histamine that is released in response to exposure to an allergen. First-generation antihistamines competitively bind H1-receptors and effectively attenuate the local effects of histamine. Unfortunately, their lipophilic nature allows them to cross the blood-brain barrier and produce central nervous system side effects such as sedation, decreased cognitive performance, decreased motor coordination, and impairment in central interpretation of vestibular input.[12] In addition, first-generation antihistamines have anticholinergic effects such as xerostomia and urinary retention. Paradoxical stimulation by antihistamines may be seen in infants and older patients.

The newer second- and third-generation antihistamines bind H1-receptors noncompetitively, are lipophobic, and have minimal anticholinergic activity. As a result, they are associated with fewer side effects, including less sedation, less psychomotor depression, and fewer anticholinergic effects.[13] They do not demonstrate the phenomenon of antihistamine tolerance, or "tachyphylaxis," which had been observed with first-generation compounds. Additionally, newer antihistamines also act directly on inflammatory mediators, diminishing their production or negating their effects. Efficacy profiles of later generation antihistamines are similar to those of the sedating antihistamines with regard to the attenuation of the irritative symptoms of allergic rhinitis, which include sneezing, pruritus, and rhinorrhea; however, neither is efficacious in alleviating congestion.[14,15] For this reason, antihistamines and decongestants such as pseudoephedrine are frequently combined.

Oral Antihistamines

First-Generation	Second- and Third-Generation
Chlorpheniramine	Cetirizine
Clemastine	Fexofenadine
Diphenhydramine	Loratadine
Hydroxyzine	Desloratadine
Promethazine	Norastemizole

A move toward topical preparations in the treatment of allergic rhinitis has included the development of several antihistamines delivered in this fashion. The first intranasal antihistamine introduced in the United States was azelastine, which appears to be equivalent to other antihistamines in potency. Unfortunately, a high incidence of taste perversion has been noted among patients using it.[16] Topical nasal formulations of levocabastine have been introduced in the United States, Canada, and Mexico. This preparation is said to be 15,000 times more potent than chlorpheniramine, with duration of effect of 24 hours or more and few if any side effects.[17]

Because of similar efficacy among older and newer generation antihistamines, selection should be based on safety, cost, physician's experience, and individual preference.

Rhinoplasty patients who have symptomatic allergic rhinitis and who take antihistamines should continue their medication regimen in the perioperative period.

Decongestants

Decongestants exert a sympathomimetic effect via α-1- and α-2-receptor stimulation. They displace norepinephrine from presynaptic sympathetic receptors and block the reuptake of norepinephrine, resulting in smooth muscle contraction and vasoconstriction. Decongestants are available as topical agents or systemic agents. Systemic formulations (pseudoephedrine and phenylpropanolamine) achieve peak levels in 1 to 3 hours and have a half-life of 3 to 4 hours. They are administered alone or as a component in many over-the-counter cold and allergy preparations. Additionally, decongestants may be formulated with prescription antihistamines (for example, Allegra-D) to relieve nasal congestion, the allergic symptom complex that is not addressed by antihistamines alone. As is the case with over-the-counter combinations, the decongestant most commonly combined with an antihistamine is pseudoephedrine, in a total daily dose of 180 to 240 mg.

Decongestants are not without their side effects. The most common side effect of systemically administered decongestants is cardiovascular stimulation. Pseudoephedrine may produce somewhat less blood pressure elevation than the other available systemic decongestants, although any decongestant may be used (albeit with caution) in patients with stable, treated hypertension.[18,19] Other cardiovascular stimulatory effects of these drugs include tachycardia, palpitations, and even arrhythmias. The central nervous system stimulation produced by decongestants is generally manifested as anxiety and insomnia. Additionally, the stimulatory side effects of systemic decongestants are enhanced by tricyclic antidepressants

and MAO inhibitors. The potentiation by MAO inhibitors may persist for up to 2 weeks after these drugs have been discontinued. Thus systemic decongestants should be administered cautiously and in reduced doses in patients with hypertension, atherosclerotic coronary artery disease, and/or hyperthyroidism, in patients taking MAO inhibitors, and in patients with urinary retention.

Topical decongestants (oxymetazoline and phenylephrine) have an onset of action of 5 minutes and a duration of more than 6 hours. They have a greater local potency and fewer systemic effects compared with systemic decongestants. A frequently encountered problem associated with prolonged use of topical decongestants is rhinitis medicamentosa; however, the risk of rhinitis medicamentosa can be minimized by limiting topical decongestant use to just 3 to 5 days.

Topical and systemic decongestants may be a beneficial symptomatic treatment modality for patients after septorhinoplasty to help reduce postoperative congestion and nasal obstruction.

The risk of rhinitis medicamentosa can be minimized by limiting topical decongestant use to just 3 to 5 days.

Nasal Saline Solution

Topical nasal saline solution has been used as an adjunct in the treatment of multiple rhinologic disorders as well as in the postoperative care of patients undergoing rhinoplasty or endoscopic sinus surgery. Saline facilitates the removal of blood clots and secretions, particularly when nasal splints are in place. Anecdotal evidence supports the efficacy of nasal saline solution. Although there have not been many scientific studies addressing the use of nasal saline, Tomooka et al[20] reported a statistically significant improvement in nasal symptoms in patients with sinonasal disease who used nasal irrigation.

Anticholinergics

Topical anticholinergic preparations (ipratropium bromide) decrease parasympathetic tone locally to decrease watery rhinorrhea, a common complaint in patients with allergic rhinitis. However, anticholinergics do not reduce congestion, irritation, itching, or sneezing. Ipratropium bromide is now available in 0.03% and 0.06% strengths in a metered-dose pump spray for intranasal use. The 0.06% strength is primarily used to alleviate the initial rhinorrhea of the common cold, whereas the 0.03% concentration is used to control rhinorrhea caused by va-

somotor rhinitis, perennial nonallergic rhinitis, perennial allergic rhinitis, and gustatory rhinitis.[21,22]

The most important factor is a sufficient dose early in the day to control symptoms, with additional dosing as necessary.[23] The recommended dosing regimen is two sprays in each nostril in the morning on arising, with subsequent doses of two sprays in midafternoon and in the evening, if needed. Often the morning dose alone suffices. In these circumstances, the use of a topical anticholinergic is not curative but will often control symptoms that are extremely bothersome to the patient. Side effects from topical nasal ipratropium are minimal, and its long-term use does not appear thus far to present a problem.

Leukotriene Receptor Antagonists

Although histamine plays a significant role as the primary culprit of the allergic reaction, leukotrienes are a group of inflammatory mediators that play a supporting role in sinonasal inflammation. Leukotrienes, formerly referred to collectively as *slow-reacting substances of anaphylaxis,* were isolated in 1983 and consist of a family of inflammatory mediators that are end-products of the arachidonic acid cascade produced in response to degranulation of mast cells.

The biologic effects of the cysteinyl leukotrienes (LTC_4, LTD_4, LTE_4) can act to trigger a number of processes important to inflammation of respiratory mucosa, including chemotaxis of inflammatory cells (for example, neutrophils, lymphocytes, eosinophils), increased permeability of vessels, and vasodilation.[24,25]

Identification of the leukotrienes as an important mediator of allergic inflammation piqued interest in the potential that blocking their effect might have on the allergic response. Leukotriene-modifying agents were first found to have a positive effect in the control of asthma and then a beneficial rhinologic application in treating allergic rhinitis, aspirin sensitivity (Samter's triad), and idiopathic nasal polyposis. Several studies have proved their efficacy in alleviating the congestive symptoms of allergic rhinitis as well as sneezing and rhinorrhea.[26] Because they improve mucus production and congestion, the treatment effect of a leukotriene inhibitor with an H1-antagonist may be additive.

Montelukast, a leukotriene receptor antagonist, acts to inhibit the action of leukotrienes at the end-organ receptor site. Studies comparing this preparation to placebo have demonstrated a statistically significant impact on both daytime and nighttime symptoms of allergy. Moreover, this class of medications has demonstrated the ability to decrease the number of activated eosinophils resident within inflamed mucosa.[27] Given the relatively novel state of this class of medications and the limited amount of data that are currently available regarding their impact

on allergic rhinitis, there is much to learn about how this class of medications may be used to positively affect patient outcomes. Initial information appears to support the use of leukotriene receptor antagonists in the treatment of symptomatic allergy, especially for symptoms of rhinorrhea and nasal congestion. The potential impact of this class of medications on eosinophils may also suggest a broader role in the treatment of inflammatory disorders of the nose and paranasal sinuses in the future.

Mast Cell Stabilizers

Cromolyn sodium (Nasalcrom, Intal) and nedocromil (Tilade) exert direct effects on mast cells by inhibiting their calcium-dependent degranulation in response to allergen exposure, although the exact mechanism of its action remains a matter of conjecture. The result is prevention of an allergic reaction when it is used before exposure to an antigen.[28] These agents may also exert a late phase inhibition of eosinophils and neutrophils. Although they are ineffective if administered immediately after allergen exposure, they are good for anticipated situational allergy if used 3 to 7 days before exposure to the inciting antigen.

Of course, to be effective, cromolyn (or any intranasally administered drug) must adequately reach the nasal mucosa. This means that it may not be appropriate for use in patients with severe septal deviation and/or marked turbinate hypertrophy. Not only will polyps prevent cromolyn from achieving adequate contact with nasal mucosa, but also the cromolyn has no effect on the polyps. Rather, it prevents the allergic event when applied beforehand, and to a much lesser degree may ameliorate symptoms of an allergic event in progress. It must be reapplied every 4 to 6 hours to remain effective. Despite these shortcomings, cromolyn is especially effective for patients with allergy to well-defined inhalants that are unavoidable and are not encountered on a continuous basis. Also, cromolyn is exceptionally safe and is probably one of the best methods of providing relief for pregnant women with mild to moderate symptoms of allergic rhinitis.

Mucolytics

Mucolytics, such as guaifenesin, decrease the viscosity of mucus and increase its volume via a vagal nerve–mediated increase in parasympathetic tone. Wawrose et al[29] found a significant decrease in congestion and thinner postnasal drip among patients with CRS, and Morgan and Petty[30] showed improvement in the frequency of cough and chest discomfort in patients with chronic obstructive pulmonary disease. However, Druce[31] found no support for the ability of guaifenesin to reduce viscosity. The role of mucolytics as a symptomatic adjunct to treatment of sinonasal disorders and in postoperative care remains unclear.

Corticosteroids

Corticosteroids, both systemic and topical, are potent antiinflammatory agents with general applications in the management of tissue inflammation, whether it is related to surgical edema, allergic phenomena, or infection.

Rhinologists have embraced the efficacy of steroids, as evidenced by the widespread acceptance of topical nasal steroids as first-line agents in the management of allergic rhinitis and their increased use in managing chronic sinonasal inflammation.

Although the targeted forms of therapy address the mediator effects of inflammation, corticosteroids exert an immunomodulatory effect to prevent initiation and downregulate the inflammatory responses. Steroids reduce the influx of inflammatory cells, attenuate the availability of inflammatory mediators, and reduce the development of hyperresponsiveness. Corticosteroids, by virtue of their lipophilic nature, directly enter the target cell and bind to a steroid receptor. The steroid-bound receptor alters mRNA transcription and ultimately protein translation to alter the expression of inflammatory mediators. Corticosteroids exhibit a profound inhibitory effect on proinflammatory cytokine production such as interleukin-1 (IL-1), IL-2, IL-2R, interferon-alpha, and tumor necrosis factor. In allergic rhinitis, the efficacy of corticosteroids in mitigating early phase reactions and late phase reactions has been well established.

Topical Intranasal Steroids

Unlike systemic corticosteroids, which almost exclusively affect the late phase allergic reaction, pretreatment with topical nasal corticosteroids for up to a week has a beneficial effect on both acute and late phase allergic reactions. Topical steroids decrease eosinophil recruitment and immigration in addition to increasing apoptosis. Additionally, they attenuate the effect of basophils and mast cells by decreasing the amount of histamine. However, it is worth emphasizing that these compounds do not prevent the allergic reaction but simply blunt the effects of the mediators thus released.

Topical nasal steroidal agents act locally on the nasal mucosa, and because their antiinflammatory action is nonspecific, they are useful in the treatment of both allergic and nonallergic rhinitis.

Effective dosing requires regular use of topical nasal steroids. Some efficacy is achieved after administration of a single dose, but the full benefit requires regular use. The effective use of nasal steroids (as with any nasal preparation) begins with the drug being able to penetrate the nasal cavity and come in contact with the target mucosa. For this reason, patients with severe septal deviation and/or significantly hypertrophic inferior turbinates will benefit to a considerably lesser degree from the use of nasal corticosteroids in comparison to patients without such obstruction. A systemic decongestant or a brief course of a topical decongestant may be necessary in conjunction with nasal steroids (especially at the initiation of therapy) to ensure adequate penetration past congested areas.

With the increasing use of intranasal steroids for the treatment of allergic rhinitis and chronic disease, there has been much debate as to their safety and the potential for local or systemic side effects. Intranasal steroids have been associated with several local side effects, including epistaxis, dryness, and burning. Local side effects may occur with any nasal steroid preparation. In addition to local discomfort caused by preservatives and vehicles, side effects frequently involve nasal crusting and dryness, epistaxis, headache, and sore throat. Excoriation or ulceration of the nasal septum may follow nasal steroid therapy, but the most likely contributory factor is trauma to the septum. This can be avoided by carefully instructing patients to direct the tip of nasal steroid sprays away from the septum (pointing it toward the corner of the eye), thereby avoiding contact with the septum.

Patients should be instructed to direct the tip of nasal steroid sprays away from the septum (pointing it toward the corner of the eye), thereby avoiding trauma to the septum and sequelae including crusting, dryness, and epistaxis.

Although there have been reports of septal perforations, several studies have demonstrated no evidence of mucosal atrophy, mucosal metaplasia, or impairment of mucociliary function.[32] The systemic availability of the topical steroids is variable. Wilson et al[33] showed that 24-hour mean plasma cortisol levels are similar across all groups. Benninger et al[34] reviewed the safety of intranasal steroids and concluded that they are not associated with systemic side effects such as the hypothalamic-pituitary-adrenal (HPA) axis suppression, linear growth, and local side effects.

Intranasal Corticosteroid Injection

The submucosal injection of a repository corticosteroid at the anterior tip of the inferior turbinates results in a slow uptake of the material with spreading to the

adjacent nasal mucosa, offering symptomatic relief of allergic rhinitis (and other forms of rhinitis) beginning within a few hours and persisting for 4 to 6 weeks. The slow absorption of the injected steroid does not generally result in suppression of endogenous cortisol production, indicating that the effect is local rather than systemic.[35]

A review of all published and available unpublished data on visual loss following intranasal steroid injection indicated that the mechanism involved was either retinal vasospasm or embolization of the injected material into the retinal circulation through collateral channels from the nose to the eye.[36] Suggestions for preventing such complications included preparing the nasal mucosa by the application of a topical vasoconstrictor–anesthetic solution, use of a fine needle for injection, avoidance of steroid preparations with large particle size and high viscosity, placement of the injection just beneath the mucosa in the anterior tip of the inferior turbinate (as far away from retinal collateral vessels as possible), and use of a very gentle technique during injection. Following these guidelines, one investigator performed more than 20,000 such injections over almost 30 years, with no visual complications.[37]

The results of an intraturbinal corticosteroid injection are usually noted within a few hours of the injection, and if triamcinolone acetonide has been injected, these effects last for 4 to 6 weeks. This procedure is extremely helpful for symptom relief in patients with severe nasal allergic symptoms limited to a single season. If several injections per year are necessary, the patient is probably a candidate for maintenance therapy with topical steroids.

Systemic Steroids

Corticosteroids are an important means of treating various types of nasal inflammation, and they are often used perioperatively for surgical treatment of AFS and CRS. However, when administered systemically, they possess a potential for producing significant adverse effects. Pharmacologic doses of systemic corticosteroids may suppress endogenous cortisol production. After the administration of 20 to 30 mg of prednisone or the equivalent for 1 week, an additional week is required for adrenal recovery; after prolonged high-dose therapy, 1 year may be required before recovery of adrenal function.[38]

Antibiotics

The role of antibiotics has been firmly established for the treatment of rhinosinusitis. However, their routine use in surgery remains a point of controversy. Topical and systemic antibiotics are frequently used in rhinoplasty. Topical antibiotic ointment has been shown to significantly decrease the growth of potentially in-

fectious nasal flora and of *Staphylococcus aureus* in patients with nasal packing.[39] In a survey of plastic surgeons, Perrotti et al[40] found that 72% of respondents used antibiotics during or after rhinoplasty, and there was a 200% increase in the use of perioperative antibiotics in rhinoplasty between 1985 and 2000.[41] Despite their widespread use and apparent efficacy, no clear guidelines exist in the literature regarding the use of antibiotics in aesthetic surgery. Frequently cited rationales for antibiotic prophylaxis in rhinoplasty are the use of intranasal splints and the fear stemming from reports of toxic shock syndrome, the clean-contaminated nature of the surgical wound, and the use of grafts.

TREATMENT STRATEGIES

Because of the prevalence of allergic rhinitis and its contributory effect on other inflammatory sinonasal disease processes, adequate control of symptoms should precede surgical intervention.

Optimizing the patient's allergic symptoms before surgery will improve patient satisfaction in the postoperative period.

Patients with allergic rhinitis are not a homogeneous group; therefore each patient requires individual consideration when choosing a pharmacotherapeutic treatment regimen to maximize symptomatic relief. Combining the individual attributes of each class of medication and matching these attributes to the individual patient will help to achieve this goal. Features that help to differentiate patients include quality of symptoms (irritative symptoms versus congestion), how predictable the allergen exposure might be (for example, predictable intermittent, nonpredictable intermittent, prolonged seasonal, or prolonged perennial), and the degree of inflammation (perhaps most important in the case of prolonged exposure to an antigen). Adherence to such a strategy will decrease the tendency to use inappropriate medications to address symptoms as well as to decrease duplication of medications within a class.

A patient with allergic rhinitis does not typically achieve relief of all symptoms with the use of a single medication. Antihistamines relieve the irritative symptoms (itching, sneezing, and rhinorrhea) that typify this disorder and have the added benefit of being relatively rapid in their onset of action. As a result, this class of medications can be used to either treat prophylactically or as a "rescue" medication to relieve symptoms after their onset. As such, a second- or third-

generation antihistamine may be given prophylactically or to relieve symptoms as needed. It is important to recognize that antihistamines fail to effectively address congestion. Decongestants are necessary to relieve nasal stuffiness.

Nasal corticosteroids have become the mainstay of the treatment of patients with more severe or chronic nasal allergic symptoms. In comparisons of the effectiveness of antihistamines versus nasal steroids, nasal steroids were found to be more effective in relieving the majority of allergy symptoms.[42] When patients have severe and/or chronic symptoms that necessitate medication on a daily basis, it is appropriate to switch to the use of a nasal steroid. This should then be used daily throughout the expected season of allergen exposure, with antihistamines and/or decongestants to be relegated to a role of augmentation as an "as needed" medication. Further, the effectiveness of nasal corticosteroids is optimized by use in a regular fashion over a period of time of up to several weeks. Conversely, nasal corticosteroids, when compared with antihistamines, are a less appropriate "rescue" choice to arrest symptoms after their onset.

In situations in which rhinorrhea does not respond to either nasal steroids or topical ipratropium, a combination of the two may be effective. The patient should be maintained on a nasal corticosteroid in the usual dosage, adding ipratropium daily with the usual morning dose and supplemental doses of ipratropium once or twice later in the day as needed. This same approach may be used in patients whose rhinorrhea is only partially relieved with antihistamines, and who (for whatever reason) are not candidates for nasal steroid therapy.

CONCLUSION

Rhinoplasty surgeons inevitably encounter therapeutic considerations when managing their patients, and a thorough understanding of nasal function as well as disorders of the nose and sinuses is requisite for positive clinical outcomes.

Rhinoplasty is not precluded in patients with allergic rhinitis, and other disease processes may warrant an otolaryngologic evaluation before proceeding with surgery.

A thorough medical history and examination may elucidate sinonasal disease conditions that may not improve after septorhinoplasty but potentially could respond to pharmacologic therapy.

KEY POINTS

- A thorough understanding of nasal function and the impact of rhinologic disease processes is crucial to the overall success of the rhinoplasty surgeon.
- Allergic rhinitis may present as a single rhinologic disease, or it may coexist with or contribute to other rhinologic disease processes.
- Rhinoplasty is generally contraindicated in the presence of active infection.
- Rhinoplasty patients who have symptomatic allergic rhinitis and who take antihistamines should continue their medication regimen in the perioperative period.
- The risk of rhinitis medicamentosa can be minimized by limiting topical decongestant use to just 3 to 5 days.
- Topical nasal steroidal agents act locally on the nasal mucosa, and because their antiinflammatory action is nonspecific, they are useful in the treatment of both allergic and nonallergic rhinitis.
- Patients should be instructed to direct the tip of nasal steroid sprays away from the septum (pointing it toward the corner of the eye), thereby avoiding trauma to the septum and sequelae including crusting, dryness, and epistaxis.
- Optimizing the patient's allergic symptoms before surgery will improve patient satisfaction in the postoperative period.
- Rhinoplasty is not precluded in patients with allergic rhinitis, and other disease processes may warrant an otolaryngologic evaluation before proceeding with surgery.

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5

Preoperative Concepts for Rhinoplasty

Rod J. Rohrich ▪ Jamil Ahmad

Thorough preoperative preparation is a fundamental component of successful rhinoplasty and the basis for consistent and reproducible outcomes.[1,2] The preoperative process includes a comprehensive nasal history, precise anatomic examination of the external and internal nasal structures, documentation of the patient's deformities, establishment of the patient's surgical goals and expectations, and reconciliation of the patient's expectations with the defined deformity. Careful attention to each of these details is essential for proper patient selection and critical to achieving a successful rhinoplasty with a satisfied patient.

Important aids to assist the surgeon in this process include standardized photography and computer imaging systems for documentation and visual explanation of the deformity and the operative goals for correcting it, a detailed printed information packet outlining the entire perioperative course, and preoperative and postoperative instructions. Finally, highly trained staff who can accurately discuss the operative process and reassure the patient along the way help to ensure that the patient will be well informed. Useful strategies for a thorough preoperative preparation are presented in this chapter.

Successful rhinoplasty begins with careful preoperative preparation and planning.

INITIAL CONSULTATION

The objective of the initial consultation is twofold: (1) to provide the surgeon with the opportunity to compile data from the patient's complete history and physical

examination, which is essential before any surgical procedure, and (2) to develop a rapport with the patient and establish a line of communication between the patient and the surgeon to determine whether he or she is an appropriate candidate for rhinoplasty.

Failure to identify poor candidates with unrealistic expectations at this stage can lead to significant problems later on. The surgeon should not be afraid to refuse to operate on any prospective rhinoplasty patient whom he or she considers unsuitable. Although this may be difficult initially, it will serve the surgeon well in the long run. Above all, the surgeon should be honest and objective with these patients about what is possible to achieve and what is not.

HISTORY

The patient's history should establish whether he or she is medically, physically, and emotionally prepared to undergo rhinoplasty. A complete and accurate history focuses on the aesthetic concerns (chief complaint), past medical history, past surgical history (nasal and other), nasal and/or upper respiratory symptomatology, history of nasal trauma, review of systems, and current medications.

The patient's chief complaint is documented in the chart. The specific reason that brought the patient to the office should be elicited. Patients who indicate multiple aspects of their nasal appearance that they find objectionable should be asked to rank them in order of importance. It is sometimes helpful to ask the patient, "If you had only one problem that could be corrected, what would it be?" The surgeon should not settle for vague descriptions or explanations, because that may lead to a potential misunderstanding of the patient's expectations. Poorly defined objectives for surgery are a red flag to not operate on that patient. Time spent understanding the patient's goals will be time saved postoperatively. Patients commonly misuse medical terminology, or they are unfamiliar with terminology used to describe anatomic structures, deformities, and surgical maneuvers in rhinoplasty. It is important to clarify these terms with the patient and present information in a manner that is easy for the patient to understand.

Essential elements of the nasal history include nasal airway problems, allergies, medications, previous nasal trauma, and prior nasal surgery.

Past medical history should be reviewed in detail to identify any medical contraindications to rhinoplasty or the need for preoperative consultation and/or medical clearance for surgery. A patient's past surgical history will help to confirm or

expand the medical history. Careful review of previous nasal surgery provides invaluable information to assess the patient's candidacy for rhinoplasty.

Attention should be paid to the number of previous rhinoplasties, whether an open or closed approach was used, and the dates when these procedures were performed. It should also be noted whether or not the procedure was successful, along with reasons for failure if that is the case, and any perioperative complications that may have occurred. Previous nasal traumas or nasal operations can alert the surgeon to potential structural abnormalities, such as septal fracture or depletion or exhaustion of local or distant graft material, so that these potential problems can be factored into the planning process.

Nasal obstruction is frequently caused by abnormalities of the nasal septum, nasal valves, or inferior turbinates, which normally regulate nasal airflow.

All nasal and upper respiratory symptoms or complaints should be thoroughly investigated; these problems are usually related to some anatomic structure or associated deformity. In patients who complain of frequent nasal obstruction, the cause is usually significant septal deviations, dysfunction of the internal and/or external valves, and/or hypertrophied inferior turbinates. The latter, which are often associated with a long history of allergic rhinitis, produce symptoms that are worse at night when the inferior turbinates become engorged.[3] These patients generally use antihistamines, local decongestants, and/or short courses of corticosteroids once or twice a year. Such patients must be told that their symptoms of allergic rhinitis may persist for a long time and may even be exacerbated during the postoperative period.

Scar contracture at right internal valve

Patients with a history of nasal surgery may have obstructions as a result of synechiae or scar contracture involving the internal structures of the nose.

Dysfunction of the nasal airway is frequently seen in secondary rhinoplasty patients and should be carefully investigated.

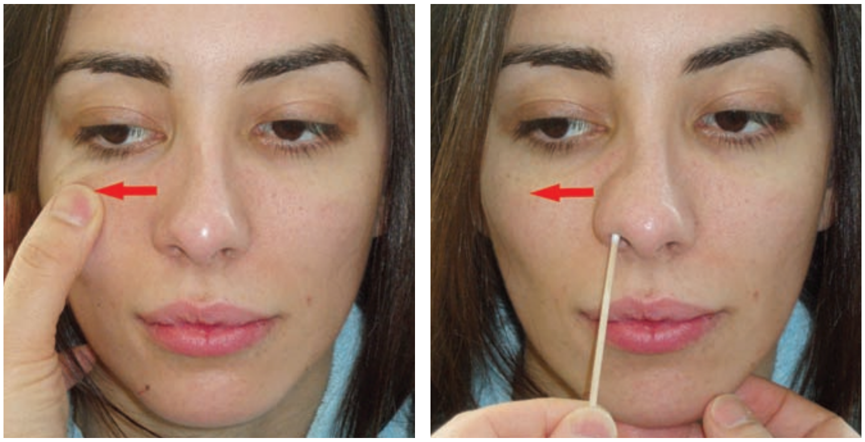
Patients should also be questioned about other factors that could complicate the operative procedure, such as sinusitis, asthma, bronchitis, tobacco and alcohol consumption, and illicit and prescription drug use. For example, medicines containing acetylsalicylic acid tend to increase the bruising and bleeding associated with surgery, whereas certain antidepressants may lead to perioperative hypertension. Smoking may increase the risk of postoperative wound healing complications and may prolong postoperative nasal obstruction, with persistent irritation of the respiratory tract.

PHYSICAL EXAMINATION

The physical examination identifies correctable nasal deformities and is used to determine whether the patient's goals and expectations are realistic. The surface anatomy of the nose directly reflects the underlying framework. A systematic, detailed examination provides the surgeon with a list of problems from which to formulate the operative plan. Examination should begin with a full facial analysis to assess facial balance and the potential benefit of adjunctive procedures. Next, the nasal structures are observed. Skin thickness and texture, nasal deviation, shape and width, alar rim morphology, tip definition, projection and rotation, nasal base width, and nostril shape should be thoroughly analyzed and documented (see Chapters 2 and 6).

The internal nasal examination includes speculum examination and dynamic maneuvers. Adequate lighting and instrumentation are requisite. In some instances, it may be necessary to perform this before and after vasoconstriction of the nasal mucosa. It is essential for assessing and documenting the preoperative status of the functional airway and for discussing the potential strategies for altering nasal appearance and the potential beneficial effects these changes may have on improving nasal airflow (for example, spreader grafts and dorsal width; alar contour grafts and alar rim appearance).

Nasal obstruction at the internal valve may be evident by analysis of the external nose. Some patients may note improvement of nasal airflow by pulling laterally on the cheek, mimicking the Cottle test.

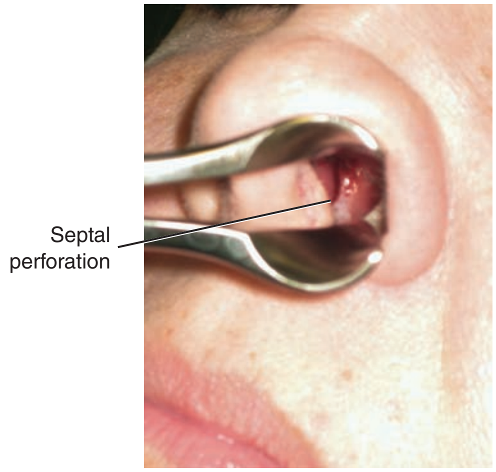


The Cottle test is performed by applying lateral traction on the medial cheek at the level of the internal valve. Subjective improvement of nasal airflow on the side tested may indicate nasal obstruction at the internal valve. Alternatively, a cotton-tipped applicator can be used to open the internal or external valve to evaluate for nasal obstruction at these sites.

Normal inspiration Forced inspiration

With normal respiration, external valve collapse may not be present, but dynamic external valve collapse can be elicited by having the patient inspire forcefully.

Gruber et al[4] described the use of nasal strips to evaluate inspiratory function at the internal and/or external nasal valve. The nasal strip is applied to the middle third or lower third of the nose, and the patient reports whether this improves, worsens, or has no effect on nasal airflow. This test can help predict whether surgical correction of nasal valvular dysfunction will improve airflow.



Identification of preexisting synechiae, septal deformities, or perforations should be reported to the patient preoperatively to avoid mistaken blame later. Abnormalities of the septum or turbinates are presented to the patient to allow discussion of surgical correction. (For a detailed description of the complete physical examination, see Chapter 44.)

Nasal obstruction is common among patients presenting for rhinoplasty. However, many patients are unaware that they have this problem and may become more aware of symptoms postoperatively if these are left untreated.

Potential cartilage donor sites (especially in secondary rhinoplasty patients) are evaluated when necessary to allow preoperative discussion and justification of distant graft sites. In patients presenting for secondary rhinoplasty or who have undergone a previous septoplasty, it is important to assess for the presence of

septal cartilage. If septal surgery has been performed previously, a cotton-tipped applicator can be used to palpate the septum to assess for rigidity if septal cartilage is still present or flaccidity if it has been harvested. Where septal cartilage has been harvested, it is important to estimate the width of the anterior septum or L-strut. This can be performed by using a cotton-tipped applicator in the dominant hand to sweep across the septum in a posterior to anterior direction toward the dorsum. The distance between the dorsal edge of the septum and where the posterior edge of the L-strut is encountered can be estimated.

Physical examination should focus on the skin envelope, the osteocartilaginous framework, internal nasal structures, and identification of potential cartilage donor sites. Evaluation of nasal airway function is included in the physical examination.

PATIENT SELECTION

After a detailed history is obtained and physical examination is completed, the surgeon should be better able to render judgment as to whether the patient is a good candidate based on the patient's goals and expectations, in conjunction with the deformities noted during physical examination. Emotional factors elicited in the history are also considered at this time. Patients presenting for aesthetic surgery during periods of significant upheaval or emotional strain should not undergo surgery, even if they possess correctable anatomic deformities. Surgery should be delayed until the other aspects of their lives are stabilized.

Congruency between the patient's and surgeon's goals and expectations is critical to successful and satisfying outcomes from aesthetic surgery.

Ideal patients are secure, emotionally stable, well informed, and understanding of the limitations of rhinoplasty, and realistic in their expectations. The acronym SYLVIA describes the appropriate female rhinoplasty patient who is **s**ecure, **y**oung, **l**istens, and is **v**erbal, **i**ntelligent, and **a**ttractive.[5,6]

Red Flags When Assessing Patients Suitability for Rhinoplasty

1. Minimum disfigurement
2. Delusional distortion of the body image
3. An identity problem or sexual ambivalence
4. Confused or vague motives for wanting the surgery
5. Unrealistic expectations of change in life situations as a result of the surgery
6. A history of poorly established social and emotional relationships
7. Unresolved grief or a crisis situation
8. Present misfortunes blamed on physical appearance
9. Older neurotic man overly concerned about aging
10. A sudden anatomic dislike, especially in older men
11. A hostile, blaming attitude toward authority
12. A history of seeing physicians and being dissatisfied with them
13. The indication of paranoid thoughts

Conversely, patients who have unrealistic expectations, insecurities, and/or excessive concerns about minimal deformities will most likely be disappointed regardless of the postoperative aesthetic improvement. Listed above are some red flags that may indicate that a patient has underlying psychological issues.[7] Examples of these patients are categorized by the acronym SIMON, which refers to an individual who is **s**ingle, **i**mmature, **m**ale, **o**verly expectant, with **n**arcissistic traits.[5,6] An emotionally unstable patient adversely influences the relationship between the surgeon and the patient and constitutes the general basis of poor results.[8]

Secondary rhinoplasty patients who express anger toward their previous surgeon or are actively involved in litigation, those desiring a result that is beyond the realm of the aesthetic norm (for example, wanting a dorsal hump created), and those with a controlling or confrontational personality should be approached with extreme caution and should not be operated on in most cases. The decision to proceed with or end the doctor-patient relationship should be made at the

completion of the assessment. Patients who are not good candidates should be told early in the process. Proceeding with imaging or further appointments will only make the process of ending the relationship more difficult and problematic.

Patients who express anger toward previous surgeons or who have personalities that are confrontational or controlling should not be operated on.

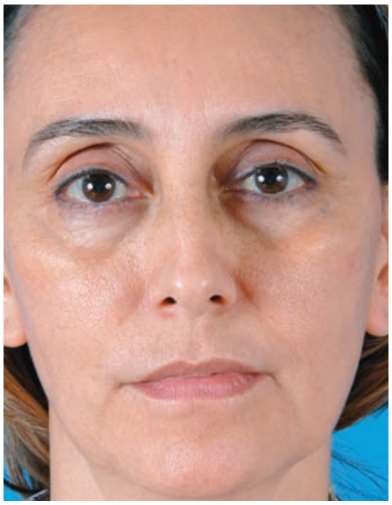
DIGITAL PHOTOGRAPHIC ANALYSIS

Standardized photography should be obtained for all patients preoperatively (see Chapter 7). Photographic analysis is a key component of the secondary examination. Subtle asymmetries and deformities are more easily identified on quality photographs and with simultaneous evaluation of the deformity in multiple views. Photographs also serve as useful visual aids in the communication process between patient and surgeon. Multiple-view photographs allow patients a chance to more accurately demonstrate their concerns, improving the surgeon's comprehension of the patient's goals and expectations.

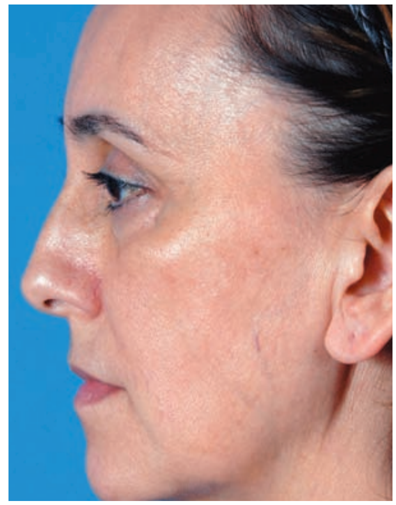
Photographs also provide a significant contribution to the medical record by documenting the preoperative and postoperative status of the patient. Good-quality photographs depend on proper positioning, cameras, lenses, and flashes.[9] Every effort should be made to standardize techniques for the purpose of comparison between visits. Digital photography has made obtaining photographs of the patient relatively easy, efficient, and cost effective. Additionally, it allows for easy storage and retrieval. We use a digital single-lens reflex system with a minimum resolution of 1600 $\times$ 1200 pixels at 300 dpi, a 105 mm lens, and dual lighting with a blue background. The images are then stored in a database to allow high-quality printing, image manipulation, and retrieval.

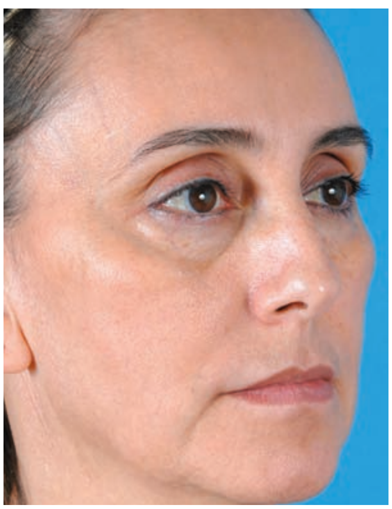
The following standardized views are obtained and analyzed in all patients:

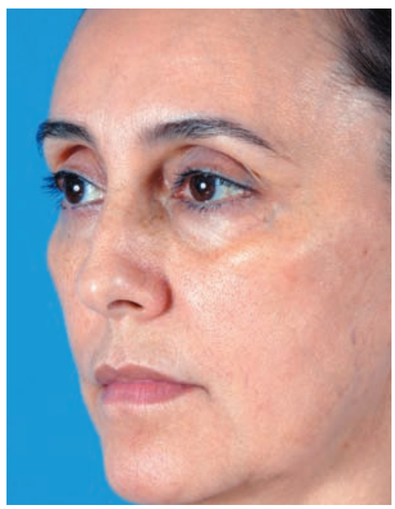
1. Anterior (frontal)
2. True lateral (right and left)
3. Oblique (right and left)
4. Basal (high and low)

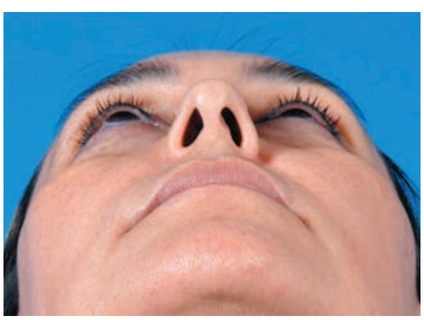

Anterior

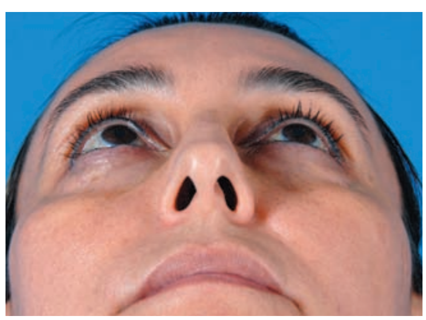

Right lateral

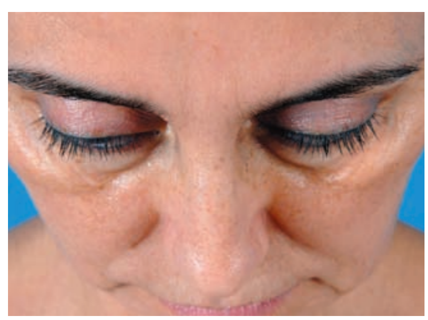

Left lateral


Right oblique


Left oblique


High basal


Low basal


Overhead

The surgeon may also use photographs to demonstrate qualities that the patient cannot appreciate such as asymmetries and disproportions seen in the lateral, basal, and bird's-eye views. Photographs from other patients may be used to demonstrate the limitations and potential complications associated with the procedure. Facial disproportions should be pointed out to the patient to demonstrate that some asymmetries may not be corrected by the surgery or that additional procedures (for example, orthognathic surgery/genioplasty) may be necessary to accomplish the patient's goals.[10]

Photographs obtained using standardized techniques include frontal, lateral, oblique, basal, and overhead views. These are essential for detailed aesthetic analysis and accurate preoperative planning.

COMPUTER IMAGING

Patients and surgeons alike want to have a visual reference for the surgical outcome. This can be provided to the patient via acetate tracings or computer imaging. These techniques allow the surgeon to simulate the proposed nasal changes and enable the patient to view and analyze them before surgery. This may alleviate anxiety and allow the patient to participate in the planning process. Imaging or other predictive tools can demonstrate the limitations of the procedure and help to establish realistic expectations.

Computer imaging is useful for showing the patient what changes may be possible with rhinoplasty.

It is important to review the purpose of these media with the patient to prevent any misinterpretation or implied guarantee. It is useful to have patients sign a disclaimer to clarify their understanding of the purpose of the imaging process. (For an in-depth discussion of computer imaging, see Chapter 7.)

All images that are viewed are only a representation of the result that could be achieved through the proposed surgery. Imaging is used as an educational tool to benefit the patient and does not guarantee any result.

Computer imaging has been an essential part of our practice for more than 20 years. It provides an important visual tool that greatly enhances patient/surgeon communication. Many commercial software systems are available for this purpose; we use an adaptation of Adobe Photoshop. Preoperative photographs are manipulated to demonstrate changes in nasal shape and are presented in a format that is easy for the patient to review.

Next, the different anatomic relationships are manipulated to mimic the changes expected from rhinoplasty. The imaging process begins with previously obtained digital images of the patient, which are duplicated side by side, with one image representing the "preoperative view" and the other the potential "postoperative view." When the desired changes are achieved, a printout is generated with the precise measurements and alterations that are to be made, and the duplicate images are saved for consultation and viewing with the patient.

These computer-generated images must be carefully assessed to ascertain that the proposed changes can realistically be achieved. This must be done before reviewing the images with the patient during a second consultation. The surgeon should not be overly optimistic about the potential results to avoid patient dissatisfaction postoperatively. The computer images are generally not given to the patient except in isolated circumstances. Computer imaging can be misconstrued by some patients to be an implied contract for postoperative appearance. Careful disclosure has prevented this from occurring in our practice. It is extremely important to specify that imaging represents the surgical goals, not the final result. Even with a successful operation, patient satisfaction frequently depends on what the patient has been promised. This disclaimer should be provided orally and as part of the written consent process to document the objective of predictive imaging.

Computer-generated images must be carefully assessed to ascertain that the proposed changes can realistically be achieved before reviewing the images with the patient during a second consultation.

AESTHETIC ANALYSIS

Balanced or harmonious facial proportions are consistent with an aesthetically pleasing overall facial form. Complete facial proportions and their relationship to the nose must always be considered because the nose occupies a central position in the overall facial aesthetics.[11] Aesthetic facial and nasal analysis in the rhinoplasty patient should be performed in a systematic manner.[12] (For further discussion of facial analysis, see Chapter 6.)

UT SOUTHWESTERN
MEDICAL CENTER

UNIVERSITY HOSPITALS & CLINICS

Authorization for Audio Recordings, Photography, or Other Images for Non-Treatment Purposes

Pt. Name: ________________________________

Address: ________________________________

____
City State Zip

MRN: ________________________________

DOB: ____________________ Sex: ______________

DOS: ________________________________

I hereby authorize the ____ at
(insert name of department)

UT Southwestern Medical Center to make audio recordings or to take photographs, videotape, or digital images of me ("Images"). I understand that UT Southwestern may use and release my images for the following purposes: (1) educational lectures and presentations for health care professionals; (2) scientific publications such as journals or books; (3) patient education materials; (4) broadcast, print or internet media.

I understand that, after release of my images, they may be subject to re-disclosure.

I understand that this authorization is voluntary and I may refuse to sign. UT Southwestern may not condition my health care services on the completion of this authorization.

Unless otherwise revoked, I understand that this authorization will expire 50 years from the date of signature. I understand that I may revoke this authorization at any time, except to the extent that UT Southwestern has relied on this authorization, by sending a written statement of revocation that specially refers to this authorization. The written statement of revocation should be forwarded to:

UT Southwestern Medical Center
Attention: Department of ________________________
(insert name of department)
5323 Harry Hines Blvd.
Dallas, Texas 75390- __________
(mail code)

I hereby release UT Southwestern Medical Center, The University of Texas and its Regents, officers, agents and employees from any and all liability connected with the capture, use, or release of my images.

By signing this authorization, I acknowledge that I have read and understand the statements contained herein. I understand UT Southwestern will provide me with a copy of this signed authorization form.

Patient:

Print Name: ______________________________ Signature: __________________________

Date: ______________________

If Patient Has a Legal Representative, Complete the Following:*

Name of Legal Representative: ____________________ Signature: __________________________

Date: ______________________ Relationship to Patient: ____________________

By signing this authorization, I certify that I have the legal authority to serve as the above named patient's legal representative.

*Note--Proof of legal authority may be required for legal representatives.

Form # FMA/AARPOINTP-001 / 10.11 Original – Health Information Management Department Copy – Patient

A standard model release form is used, as shown.

Systematic Nasal Analysis

View	Characteristics
Frontal	
Facial proportions	
Skin type and quality	Fitzpatrick type; thin or thick; sebaceous
Symmetry and nasal deviation	Midline; C-; reverse C-; S- or S-shaped deviation
Bony vault	Narrow or wide; asymmetrical; short or long nasal bones
Midvault	Narrow or wide; collapsed; inverted-V deformity
Dorsal aesthetic lines	Straight; symmetrical or asymmetrical; well- or ill-defined; narrow or wide
Nasal tip	Ideal, bulbous, boxy, pinched; supratip; tip-defining points; infratip lobule
Alar rims	Gull-wing–shaped facets; notching; retraction
Alar base	Width
Upper lip	Long or short; dynamic depressor septi muscles; upper lip crease
Lateral	
Nasofrontal angle	Acute or obtuse; high or low radix
Nasal length	Long or short
Dorsum	Smooth; hump; scooped out
Supratip	Break; fullness; pollybeak
Tip projection	Overprojected or underprojected
Tip rotation	Overrotated or underrotated
Alar-columellar relationship	Hanging or retracted alae; hanging or retracted columella
Periapical hypoplasia	Maxillary or soft-tissue deficiency
Lip-chin relationship	Normal; deficient
Basal	
Nasal projection	Overprojected or underprojected; columella-to-lobule ratio
Nostril	Symmetrical or asymmetrical; long or short
Columella	Septal tilt; flaring of medial crura
Alar base	Width
Alar flaring	

After determining the operative goals for the patient, an operative plan is developed, and a graphic worksheet is completed and added to the patient's record. The worksheet shown details the intended operative approach and sequence, the source of autologous grafts, and the planned osteotomies.

OPERATIVE PLAN

Type
- ☐ Primary
- ☐ Secondary
- ☐ Partial
- ☐ Deviated
- ☐ Cleft lip-nose
- ☐ Ethnic
- ☐ Other

Approach
- ☐ Cartilage splitting
- ☐ Cartilage delivery
- ☐ Endonasal (closed)
- ☐ External (open)
- ☐ Other

Tip/Lateral Crura
- ☐ Complete rim strip
- ☐ Alar contour
- ☐ Lateral crural strut
- ☐ Attenuated
- ☐ Morselized
- ☐ Transected/Resected
- ☐ Anterior
- ☐ Posterior
- ☐ Other

Tip/Medial Crura
- ☐ Sutured domes
- ☐ Sutured to strut
- ☐ Resected
- ☐ Caudal margin
- ☐ Vertical segment
- ☐ Other

Tip/Miscellaneous
- ☐ Columellar strut
- ☐ Tip graft
- ☐ Alar spreader graft
- ☐ Unusual suturing
- ☐ Resected caudal septum
- ☐ Caudal septal repositioning
- ☐ Alar base resection
- ☐ Other

Effect on Tip
- ☐ Increased tip projection
- ☐ Decreased tip projection
- ☐ Increased tip rotation
- ☐ Lengthened nose
- ☐ Altered columellar-alar relationship
- ☐ Altered columellar-labial angle
- ☐ Other

Dorsum
- ☐ Reduction
- ☐ Augmentation
- ☐ Altered N-F angle
- ☐ Widened
- ☐ Spreader grafts
- ☐ Autospreader flaps
- ☐ Other

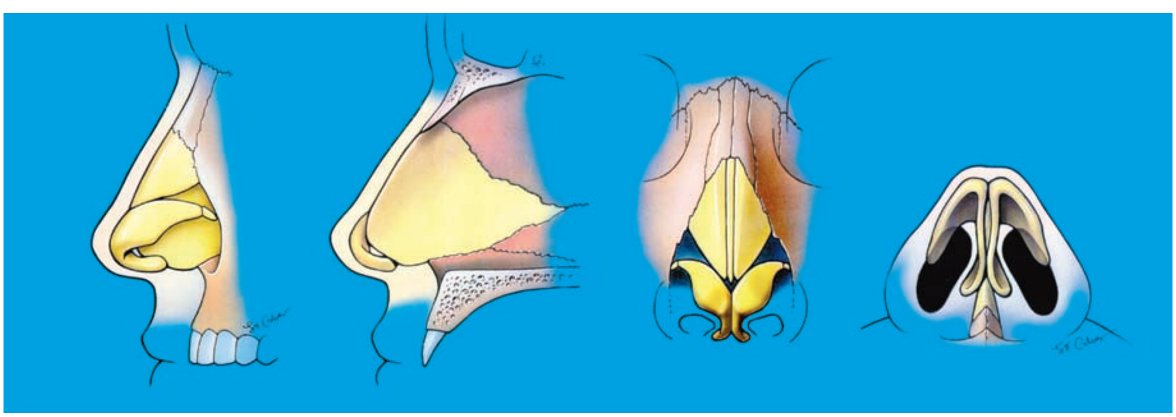
Nasal Bones
- ☐ Medial osteotomies
- ☐ Lateral osteotomies
- ☐ Complete
- ☐ Greenstick
- ☐ Multiple
- ☐ Other

Grafts (autologous)
- ☐ Septal
- ☐ Auricular
- ☐ Rib
- ☐ Temporal fascia
- ☐ Implants
- ☐ Homologous cartilage
- ☐ Other

Miscellaneous
- ☐ Nasal septum resection
- ☐ Resection of turbinates
- ☐ Mentoplasty
- ☐ Augmentation
- ☐ Reduction
- ☐ Frenuloplasty
- ☐ Malar augmentation
- ☐ Repair of septal perforation
- ☐ Banked cartilage
- ☐ Other

Degree of Difficulty

1	6
2	7
3	8
4	9
5	10



PREOPERATIVE PATIENT PREPARATION

At the conclusion of the initial consultation, the patient is interviewed by a patient coordinator who provides a comprehensive preoperative information packet. This packet includes relevant informed consent forms, names and phone numbers of the appropriate staff members, financial/billing requirements, directions to local surgical facilities, preoperative and postoperative instructions, a list of medications to avoid, and the expected postoperative convalescence.

During this interview the patient coordinator further discusses the patient's expectations, the anticipated length of the surgery, and the inpatient/outpatient admission status. Potential complications are fully outlined and disclosed before informed consent is obtained for rhinoplasty and any other indicated procedure.[13,14] Patients are instructed that if revision surgery is necessary, it is usually performed after 1 year, and they are informed of the fees for which they may be financially accountable.

FINANCIAL ASPECTS

The pertinent financial arrangements are generally addressed by the patient coordinator or other staff members. Patients should be provided with the exact amount of the surgeon's fees and an estimate of the surgical facility fees. To ensure patient compliance, surgical deposits or payments are due 2 weeks in advance of the procedure. Patients sign documents accepting financial responsibility at the time of registration, along with the explanation of surgical billing practices.

Even if surgery is only being considered, the patient is informed about the surgical procedure, the fee, the location of the surgical facilities, and the preoperative orders. Establishing these facts at the consultation saves time and money by reducing the need for repeated telephone conversations. When a date is set for the surgery, the preoperative and postoperative visits are also scheduled.

Procedures with a medical component may require application for preapproval by a medical insurance carrier. The patient is sent a copy of any correspondence with the medical insurance carrier and is encouraged to provide assistance in obtaining approval for the functional aspect of the rhinoplasty. Except when the deformity is caused by documented nasal trauma, the improvements in appearance are considered cosmetic and must be paid for by the patient before surgery.

All preoperative and postoperative instructions as well as prescriptions are sent to the patient 2 weeks before the date of the surgery.

Preoperative planning concludes with a review of the proposed surgical procedure and goals, an accurate assessment of the surgical charges, and a detailed review of the preoperative and postoperative instructions.

SECOND CONSULTATION

Some patients, especially secondary rhinoplasty patients, may benefit from a second consultation that provides an opportunity to ask questions, review the results of computer imaging, read the consent forms, discuss the surgical procedure and its potential complications, and reconsider the decision to undergo surgery. This visit also provides the surgeon with an opportunity to reevaluate the patient and the surgical plan. In addition, the psychosocial status of the patient is again reviewed to determine his or her suitability for surgery. This is especially important for a secondary rhinoplasty patient or a patient whose ability to understand the goals and limitations of rhinoplasty is in question.

MORNING OF SURGERY

The morning of surgery is the final opportunity for the surgeon to clarify final questions from the patient. The postoperative instructions are again explained to the patient and to any caregivers who may be providing postoperative care. The patient and caregiver are provided with an additional set of postoperative instructions the morning of surgery. The first postoperative visit is scheduled for 5 to 7 days postoperatively.

The goal of patient management is to plan everything in advance, discuss each step with the patient, and provide the patient with an opportunity to explore all of the options.

KEY POINTS

- Successful rhinoplasty begins with careful preoperative preparation and planning.
- Essential elements of the nasal history include nasal airway problems, allergies, medications, previous nasal trauma, and prior nasal surgery.
- Nasal obstruction is frequently caused by abnormalities of the nasal septum, nasal valves, or inferior turbinates, which normally regulate nasal airflow.
- Dysfunction of the nasal airway is frequently seen in secondary rhinoplasty patients and should be carefully investigated.
- Nasal obstruction is common amongst patients presenting for rhinoplasty. However, many patients are unaware that they have this problem and may become more aware of symptoms postoperatively, if left untreated.
- Physical examination should focus on the skin envelope, the osteocartilaginous framework, internal nasal structures, and identification of potential cartilage donor sites. Evaluation of nasal airway function is included in the physical examinations.
- Congruency between the patient's and surgeon's goals and expectations is critical to successful and satisfying outcomes following aesthetic surgery.
- Patients who express anger toward previous surgeons or who have personalities that are confrontational or controlling should not be operated on.
- Photographs obtained using standardized techniques include frontal, lateral, oblique, basal, and overhead views. These are essential for detailed aesthetic analysis and accurate preoperative planning.
- All images that are viewed are only a representation of the result that could be achieved through the proposed surgery. Imaging is used as an educational tool to benefit the patient and does not guarantee any result.
- Computer imaging is useful for showing the patient what changes may be possible after rhinoplasty.
- Preoperative planning concludes with a review of the proposed surgical procedure and goals, an accurate assessment of the surgical charges, and a detailed review of the preoperative and postoperative instructions.
- The goal of patient management is to plan everything in advance, discuss each step with the patient, and provide the patient with an opportunity to explore all of the options.

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6

Nasofacial Proportions and Systematic Nasal Analysis

Rod J. Rohrich ▪ Jamil Ahmad ▪ Jack P. Gunter

Attractive faces have certain proportions and relationships in common.[1-12] To make an accurate diagnosis and establish the best treatment plan for a rhinoplasty patient, these proportions and relationships must be thoroughly analyzed. When disproportions and poor relationships are present, correction may only be possible with major orthognathic or even craniofacial procedures. However, these discrepancies should be discussed with the patient and taken into consideration when determining the surgical procedure best suited for that particular patient.

In addition, the shape, proportions, and relationship of the different parts of the nose itself should be thoroughly studied. Closer scrutiny of these areas has taught us that instead of performing a routine reduction rhinoplasty, better results may be obtained in some cases if we augment certain areas of the nose. For example, enhanced nasofacial balance may be achieved by increasing tip projection, dorsal augmentation, lowering retracted alar rims, or lengthening a short nose.

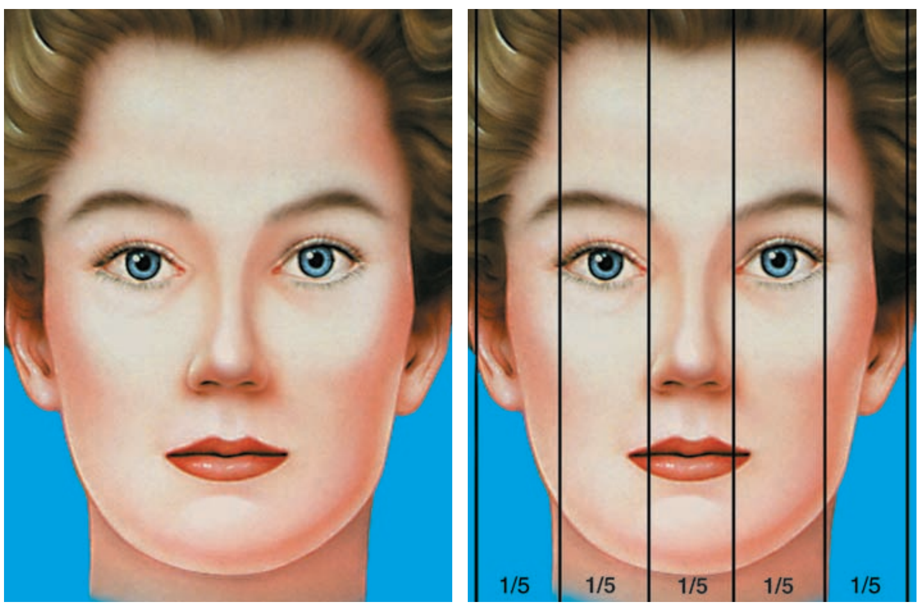
In this chapter we will illustrate the nasofacial proportions and relationships found to be helpful in evaluating a patient for rhinoplasty. This is not meant to be a complete compilation of facial measurements and proportions but instead should provide a framework for the rhinoplasty surgeon to use as reference. The relationships and proportions detailed here can serve as a foundation for analyzing a face and help in understanding what gives a face its individual appearance. Rhinoplasty surgeons should keep in mind that these relationships are not absolute; many attractive faces have harmonious nasofacial relationships despite

having less than ideal proportions. Sex- and ethnic-specific aesthetic ideals and proportions as well as considerations in the aging population are discussed in the respective chapters. In addition, we present our approach to nasal assessment, which allows systematic and comprehensive nasal analysis to identify nasofacial disproportions and imbalances and helps to identify the goals for rhinoplasty surgery.[1]

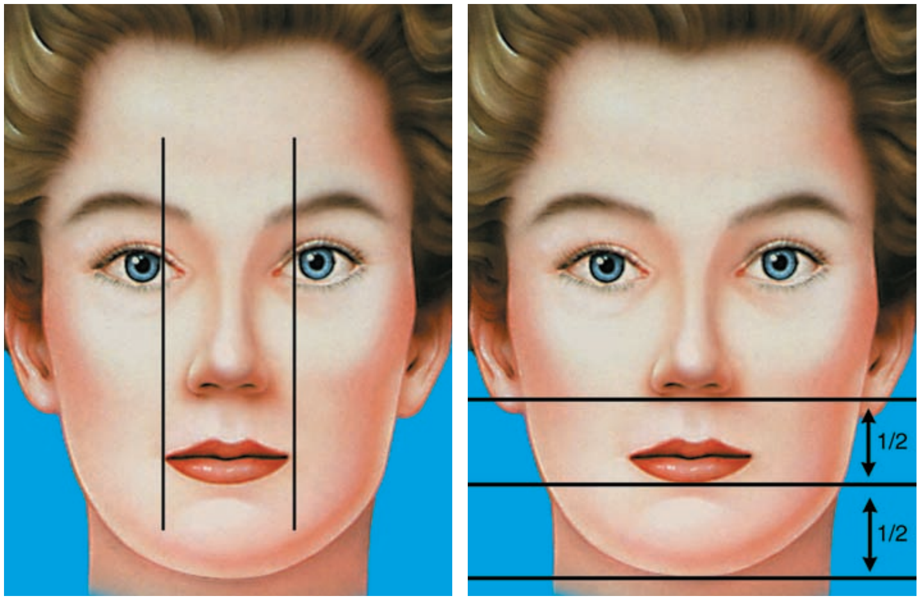
NASOFACIAL PROPORTIONS

Proportions of the Face

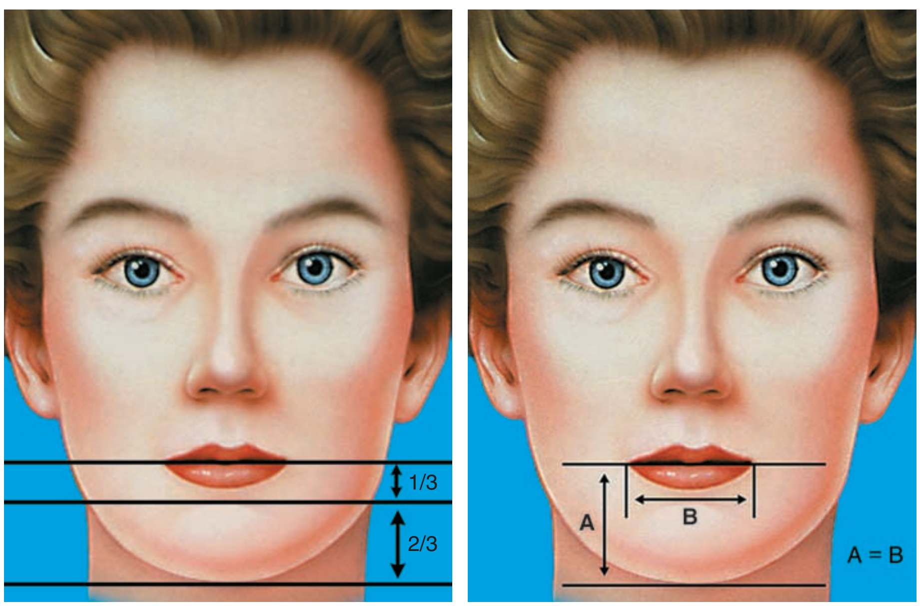
Facial symmetry should always be assessed. Most patients' faces are not symmetrical. It is very common for patients to be unaware of their facial asymmetries and nasal deviation. Because most patients are highly critical of their appearance after surgery, any asymmetries or other preexisting flaws should be pointed out preoperatively to prevent patients from attributing them to the surgery.



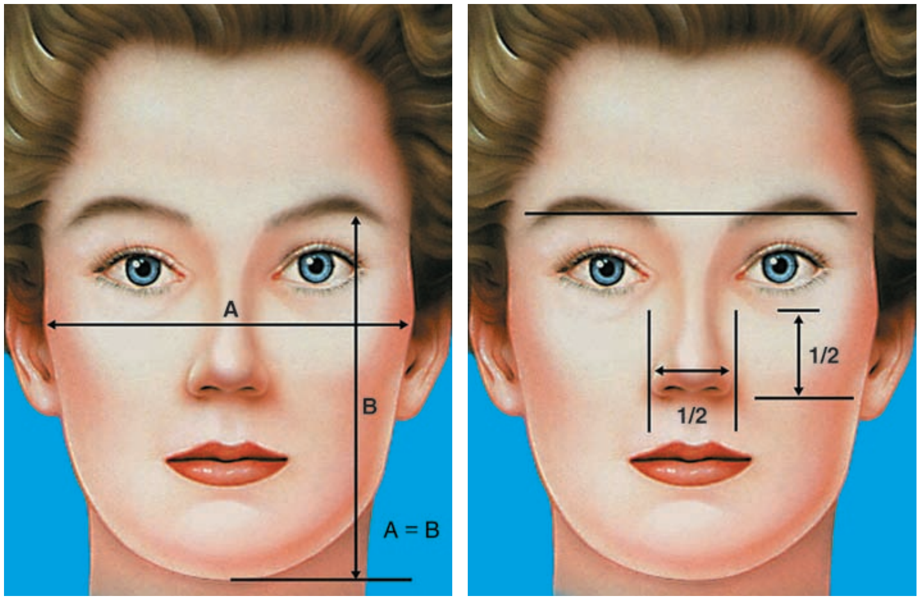
This is a frontal view of a face drawn with aesthetic proportions. The face is divided into vertical fifths by lines drawn adjacent to the most lateral projection of the head, the lateral canthi, and the medial canthi.



The width of the mouth approximates the distance between the medial limbi of the corneas. The lower third is equally divided by a horizontal line adjacent to the lowest point of the lower lip vermilion.

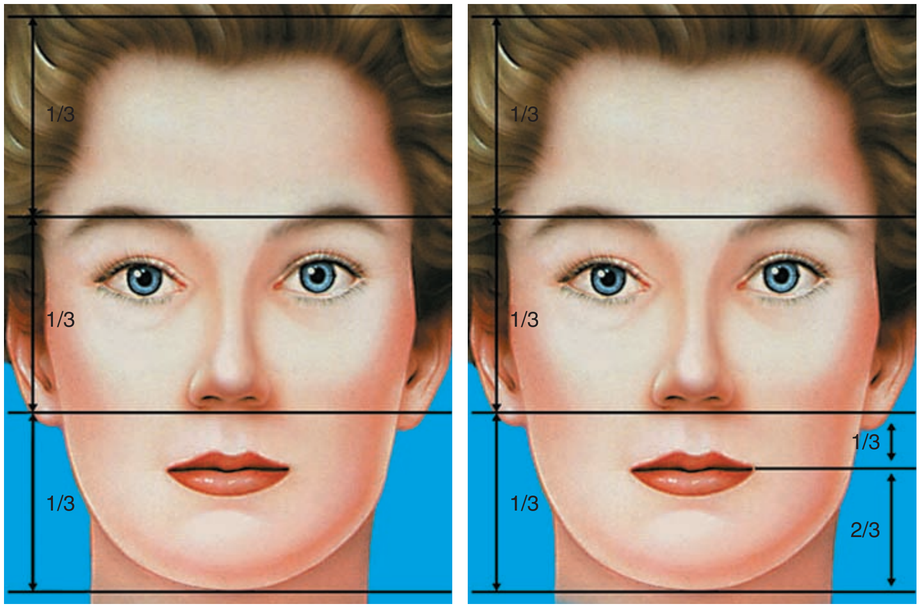


A horizontal line through the labial-mental groove divides the distance from the stomion to the menton (lowest point of the chin) into a 1:2 ratio. The width of the mouth and the distance from the stomion to the menton are equal.



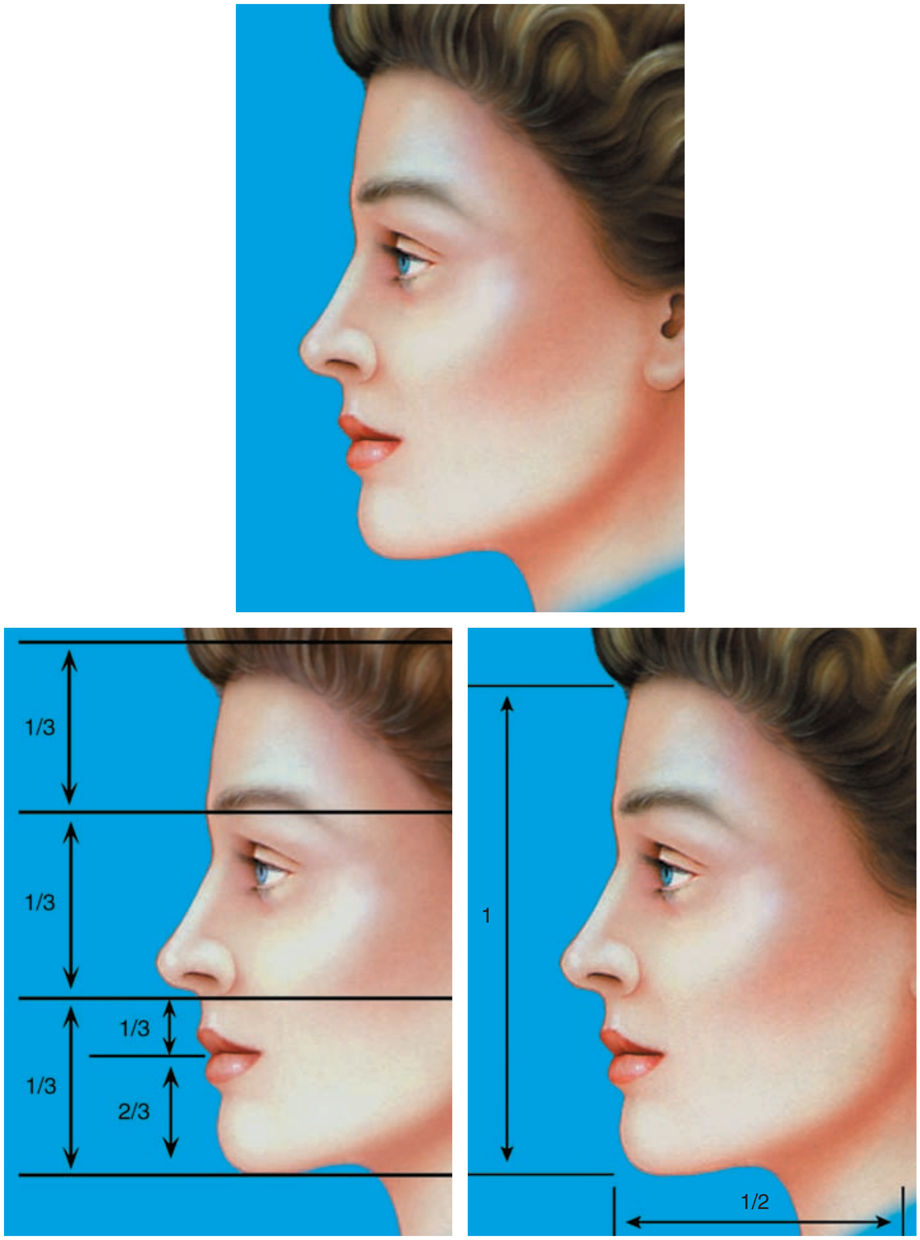
The distance from the brows to the menton *(B)* is equal to the width of the face at the malar level. The distance from the infraorbital rim to the base of the nose is equal to the width of the nasal base and one half the distance of the middle third of the face.

The facial skeleton should be evaluated for deformities such as maxillary or mandibular hyperplasia and hypoplasia, periapical hypoplasia, and malar prominence or recession. Adjunctive procedures such as orthognathic surgery, piriform aperture augmentation, or malar augmentation may be considered.

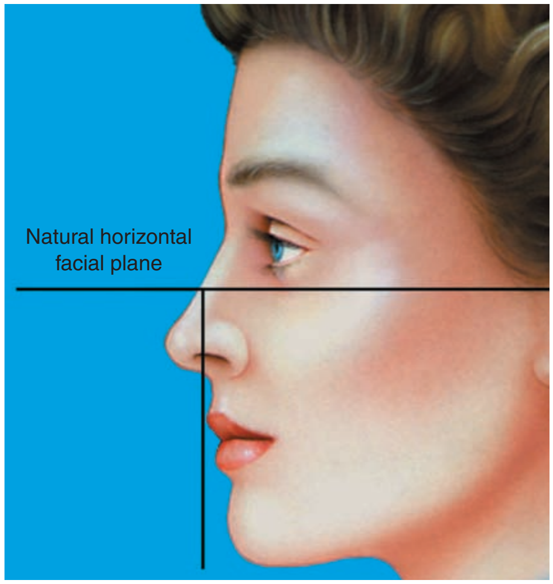


The relationships between the mandible and maxilla are of utmost importance and are determined next. The face is divided into thirds by horizontal lines drawn adjacent to the menton, the nasal base, the brows (supraorbital notch level), and the hairline (the upper line varies with hairstyle, so this landmark is least important). The lower third is divided into an upper third and lower two thirds by a line drawn through the oral commissures.

When these relationships are outside the normal ranges, optimal improvement of the patient's appearance may require orthodontics or orthognathic surgery as well as rhinoplasty for the best aesthetic results. In addition, the prominence of the different areas of the maxilla should be observed. In some patients with periapical hypoplasia, the upper lip may appear prominent. Augmentation of the piriform aperture may be indicated as an adjunct to rhinoplasty. Malar prominence should also be assessed. Weak malar eminences detract from the facial appearance, and augmentation may need to be considered.



This lateral view is drawn with aesthetic proportions showing the face divided into horizontal thirds on profile. The distance from the mandibular angle to the menton is one half the distance from the menton to the natural hairline.



Given the importance of lip position and contour in assessing nasal tip projection and rotation, the lip-chin complex should be evaluated before proceeding with the nasal analysis. The desired relationship of the lip-chin complex is an upper lip that projects approximately 2 mm more than the lower lip. In women, the chin lies slightly posterior to the lower lip. In men, it is slightly stronger. If the upper lip is not in good position or does not have good contour, it may be corrected at the time of rhinoplasty. Some patients have a "tension lip," which is characterized by fullness at the columellar-labial angle and a thin lip and vermilion surface that appears slightly retracted. This is most often seen in patients with overprojecting noses and can often be relieved by setting the nasal tip back closer to the face. Tension lip is occasionally seen in patients with deficient tip projection. When this is the case, it is usually best to relieve the tension by releasing the base of the nose, allowing it to settle posteriorly, and augmenting the tip with a graft to gain as much projection as possible.

The upper lip should be evaluated for position and contour; specifically, a tension lip can be associated with an overprojecting nose as well as an underprojecting nose. The rhinoplasty procedure can be designed to help decrease the tension lip appearance.

Another cause of an abnormal looking upper lip is a prominent posterior caudal septum. This creates fullness at the columellar-labial junction and gives the appearance of pseudorotation of the nose. This is corrected by resecting a portion of the posterior caudal septum. The anterior nasal spine is usually not involved in this deformity, and it is seldom necessary to resect any portion of the anterior nasal spine.

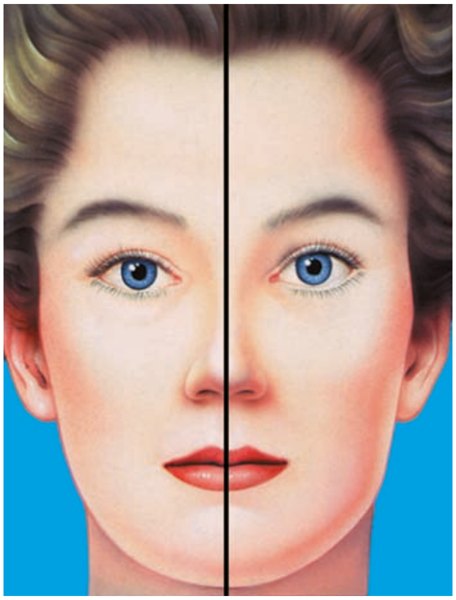
Pseudorotation is observed when there is a prominence of the posterior caudal septum, which provides fullness in the columellar-labial junction.

Increased projection of the upper lip may be caused by prominent or improperly inclined central incisors. Reducing the projection will require orthodontics or orthognathic surgery. Such a deformity should be discussed to see if the patient is interested in having it corrected before rhinoplasty. If not, at least the patient will be aware that the overall result of the surgery will be somewhat compromised.

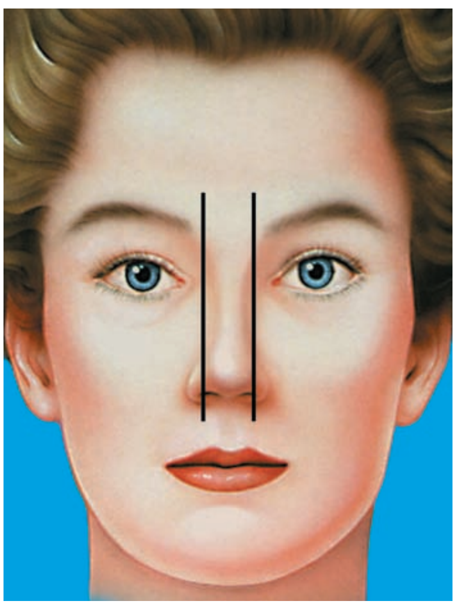
Proportions of the Nose

Clinical analysis and diagnosis of external nasal deformities are performed using the measurements and proportions described herein as standard references. The skin type and texture should be evaluated first. If the skin is thick and sebaceous, it does not drape as well as thin skin and takes longer for the edema to subside before the final result is seen. On the other hand, thin skin sometimes drapes too well and after the edema subsides it shows small deformities underneath the skin. Thick skin will also have less capability to retract after significant reductions in the osteocartilaginous framework. Although most sebaceous skin is thick, occasionally a patient will have sebaceous, oily skin that is thin. The thickness of the skin is more important than its sebaceous character in predicting the way it will drape.

The thickness of the skin should be evaluated because thick skin will not drape over the reconstructed osteocartilaginous framework as well as thinner skin and will be edematous for a longer period. When thin skin redrapes over the osteocartilaginous framework, it is more likely to show deformities than thick skin.

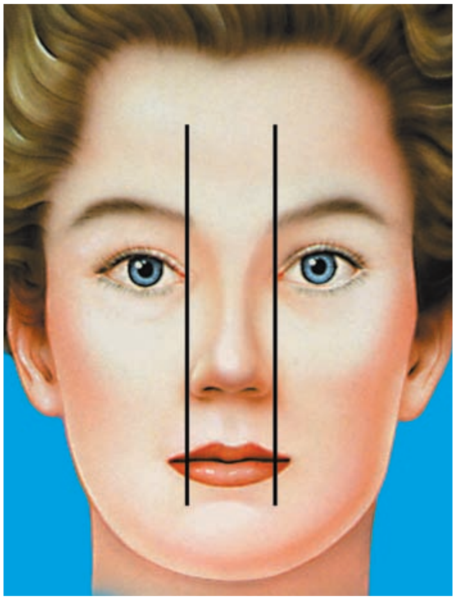


After the skin is analyzed, the nose is evaluated for possible deviation. A line from the midglabellar area to the menton should bisect the nasal bridge, the nasal tip, and Cupid's bow. If deviation is present, the cause must be determined. Some deviations will require septal surgery for correction, whereas others may be corrected with osteotomies or camouflage.



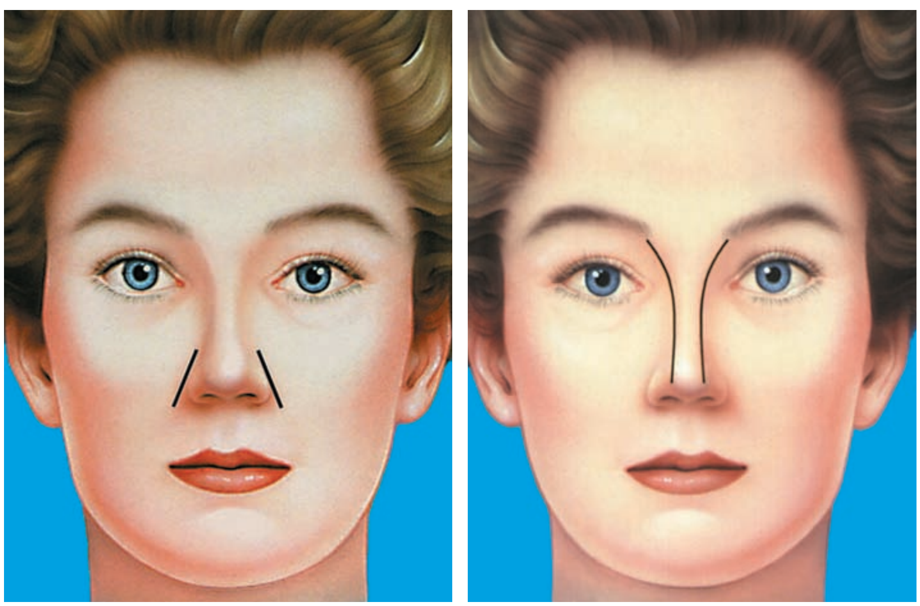
Next, the width of the body and the tip of the nose are assessed. If the distance between the nasal-cheek junction is more than 80% of the normal alar base width, the bony base should be narrowed at the time of osteotomy. If the bony base width is within the normal range but the bony dorsum is wide, mobilization of the nasal bones will be required to narrow the dorsal portion of the bones while keeping the bony base width the same. Maintaining the bony base width may require packing between the lateral osteotomy sites and the septum. In a nose that has never been operated on, it is seldom necessary to try to widen the bony base.

The width of the bony vault of the nose should be 80% of the width of the nose at the alar bases, assuming the width at the alar bases is normal.

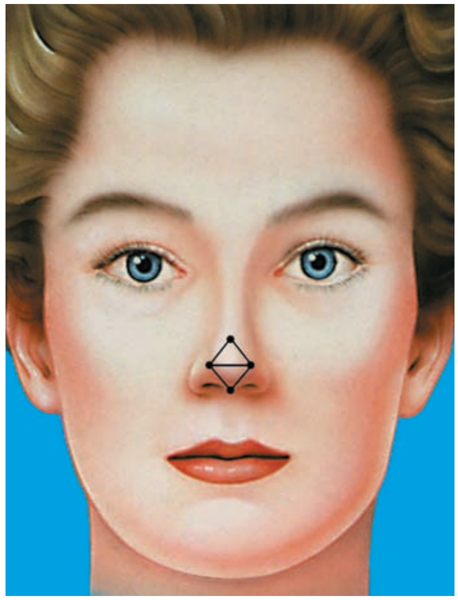


The width of the alar base should be approximately the same as the intercanthal distance, which should be the same as the width of an eye. If the intercanthal distance is smaller than the width of the eye, it is better to keep the nose slightly wider than the intercanthal distance. If the nose is wider than the width of the eye, alar base resection for narrowing should be considered.

The alar base width should approximate that of the intercanthal distance and palpebral fissure width.



The alar rims should have a slight outward flare in an inferior direction. The nasal dorsum should be outlined by two slightly curved divergent lines extending from the medial supraciliary ridges to the tip-defining points.

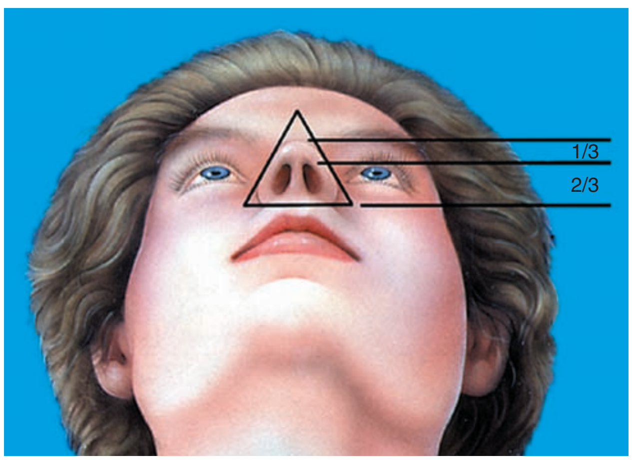


On the frontal view the tip should have four defining landmarks: A tip-defining point on each side, the supratip break, and the columellar-lobular angle. Lines connecting the tip-defining points with the supratip break and columellar-lobular angle should form two equilateral triangles. If any of these four landmarks are not in the correct position, it must be determined which is out of position and why. Tip modification will be required to correct this problem.

The tip is evaluated by locating the tip-defining points on each side, the point of the supratip break above, and the columellar-lobular angle below. Any discrepancy in the two equilateral triangles formed by these points should be evaluated to determine the cause.

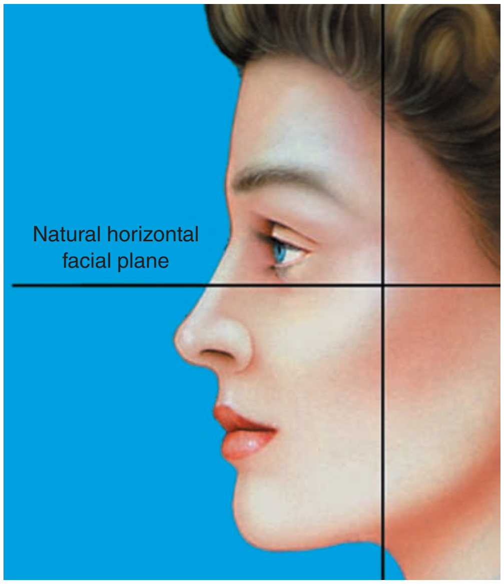
The degree of bulbosity of the tip should also be noted. If the tip is bulbous or boxy, the lower lateral cartilages will probably need to be attenuated. If thick skin is contributing to the problem, debulking of the musculoaponeurotic layer may help. If an increased distance between the domes is the cause, they will have to be moved closer together.

The columella is inspected on the frontal view. It should hang just inferior to the alar rims so that a line outlining the rims and the lowest portion of the columella will give a gentle gull wing appearance. Too much curve of this line indicates an increased infratip lobular height, which will require reduction. A straight line signifies decreased columellar show, which will require columellar augmentation and/or superior movement of the alar rims.

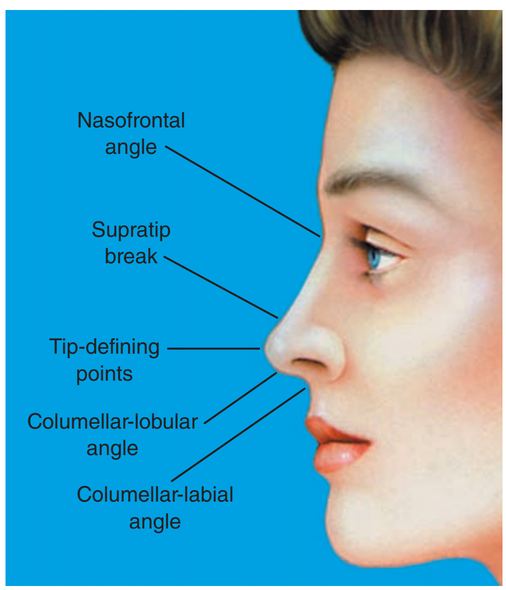


On inspection of the basal view, an equilateral triangle should be visualized. The ratio of the columella to the lobular portion of the nose should be 2:1, and the nostrils should be teardrop shaped with the long axis from the base to the apex oriented in a slightly medial direction. From the junction of the columella with the lobule, the sides of the columella should be fairly straight down to the point where the medial crura start to flare. If the medial crura flare too soon, the columella may appear short and diminish the teardrop shape of the nostril. When this happens, removal of some of the soft tissue between the feet of the medial crura, reduction of their flare by incising the cartilage where they start to flare, and suturing the feet together may be indicated.

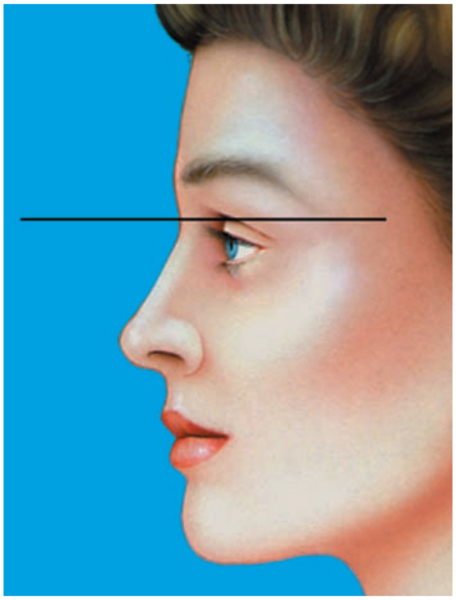
On the basal view the nose should form an equilateral triangle. The ratio of the columellar to the lobular portion of the nose should be 2:1, and the nostrils should be teardrop shaped.



All profile views should be with the head in the natural horizontal head position. In this position the neck and chin area should be relaxed with the eyes focused on a distant point at eye level. With the head in this position, any line through the face on a horizontal plane will be in the natural horizontal facial plane. The natural horizontal facial plane is determined by drawing a line perpendicular to a plumb line superimposed over the head at rest with the eyes in forward gaze. This plane may be on the same plane as the Frankfort line, but it may differ because of the varying position of the external auditory canal in individual patients. All facial angles should be measured from the natural horizontal facial plane when they differ from Frankfort's line.

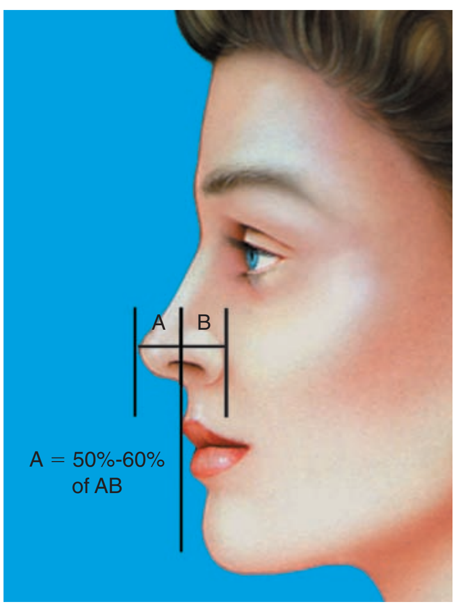


On the lateral view, these nasal landmarks should be evaluated: nasofrontal angle, supratip break, tip-defining points, and columellar-labial angle. The angle between the tip-defining points and the columellar-labial angle is the columellar-lobular angle.



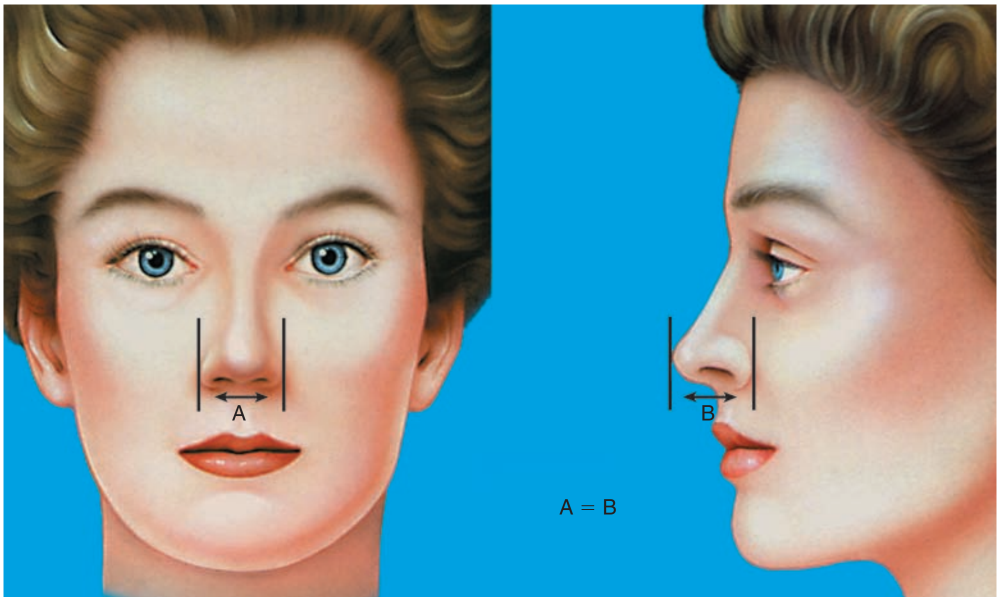
The position of the nasofrontal angle is evaluated first on the profile view. The angle should start at the infrabrow area and be a gentle, concave curve that connects the brow with the dorsum. The deepest part of the nasofrontal angle should lie between the upper eyelash line and supratarsal fold with the eyes in forward gaze. There are no standard parameters for determining the correct depth of the angle; therefore the surgeon must use aesthetic judgment to determine whether it is too shallow or too deep.

On the profile view, the deepest portion of the nasofrontal angle should lie between the upper eyelash line and the supratarsal fold with the eyes in forward gaze. An abnormal position may give the appearance of a long or shortened nose.

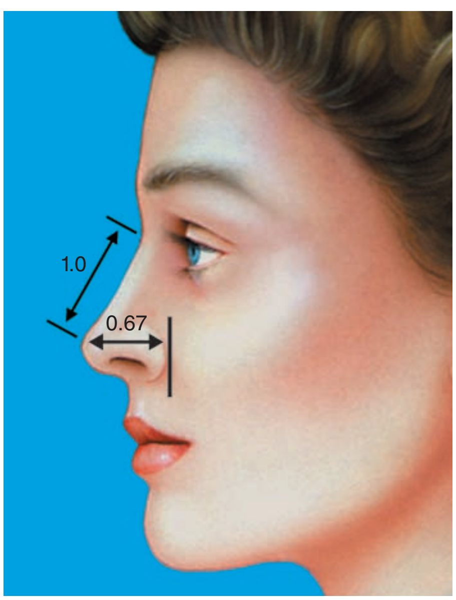


Nasal tip projection is determined next. Several different methods of evaluating tip projection have been described. Tip projection can be evaluated by drawing a line from the alar-cheek junction to the tip of the nose. If the upper lip projection is normal, a vertical line is drawn adjacent to the most projecting part of the upper lip. To achieve adequate tip projection, at least 50% of the horizontal line should lie anterior to the vertical line. If more than 60% of the line lies anterior to it, the tip is considered to be overprojecting and should be reduced. If less than 50% of the tip is anterior to the vertical line, this indicates a short nose with inadequate projection that should be augmented.

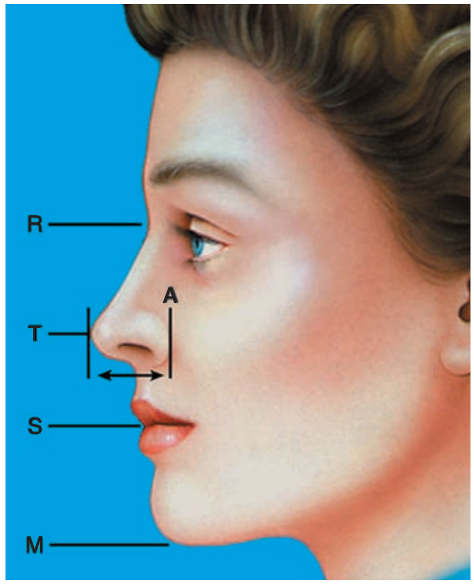
For evaluating tip projection, a vertical line should be drawn adjacent to the most projecting part of the upper lip, and at least 50% to 60% of the tip should lie anterior to this line. This assumes that the upper lip has normal projection. The length/projection ratio should be 1:0.67.



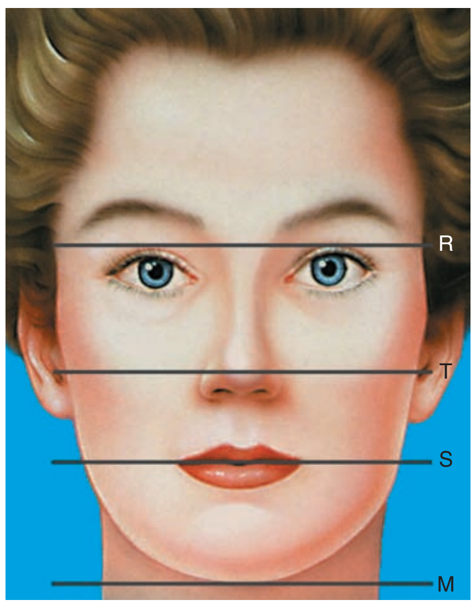
Another method to evaluate tip projection is to determine whether tip projection equals alar base width.



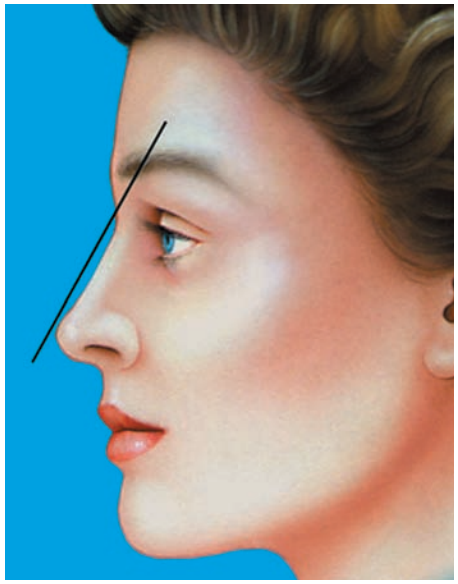
If the nasal length is correct, the ratio of nasal length to tip projection should be approximately 1:0.67.



Tip projection can also be determined in relation to ideal nasal length; ideal tip projection (AT) = 0.67 × ideal nasal length (RT).



The length of the nose should also be considered when determining tip projection and rotation. The ideal nasal length (RT) should equal the distance from the stomion to the menton (SM), which equals 1.67 × TS.

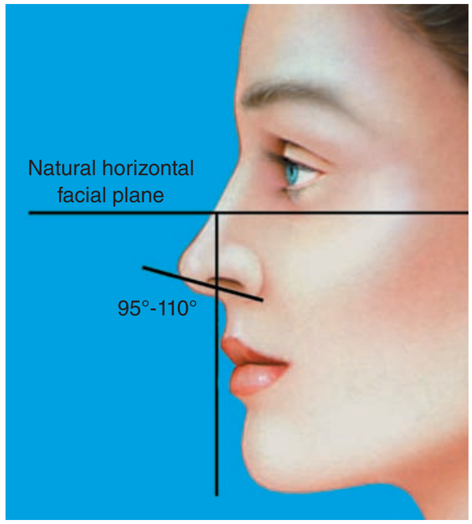


With the desired tip projection determined, the nasal dorsum is then evaluated. In women it should lie approximately 2 mm posterior and parallel to a line connecting the nasofrontal angle with the desired tip projection and should be slightly more anterior in men. If it is too far posterior to this line, augmentation will be required. If it is on the line or anterior to it, reduction is indicated. A slight supratip break of the dorsum is preferred, especially in women. This gives the nose more definition and helps demarcate the body from the tip.

After the desired tip projection has been determined, the nasal dorsum is evaluated to see if reduction or augmentation is indicated.

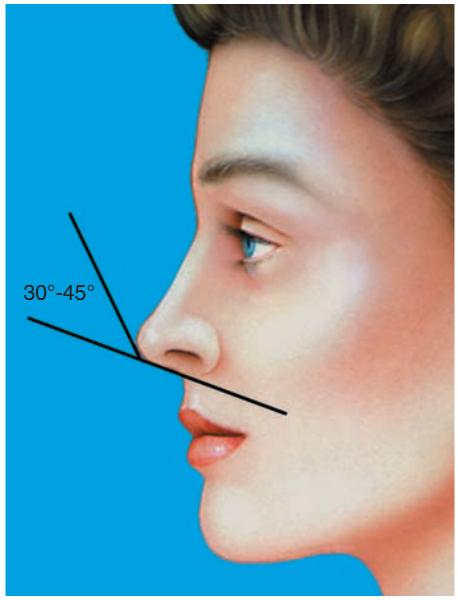
Overprojection of the nasal tip may manifest as a "tension tip" deformity. This tip deformity is usually septal dependent with the appearance of the anterior septum pushing the tip away from the face and in some cases rotating the tip complex inferiorly. There is typically supratip fullness, blunting of the columellar-labial angle, and shortening of the upper lip creating the "tension lip" deformity.

Overprojection of the nasal tip may manifest as a "tension tip" deformity.



Next, the degree of tip rotation is determined. Rotation is determined by the degree of the nasolabial angle (angle of rotation), which is not the same as the columellar-labial angle. The nasolabial angle is measured by drawing a straight line through the most anterior and posterior points of the nostrils as seen on the lateral view. The angle this line forms with a perpendicular line to the natural horizontal facial plane is the nasolabial angle.

We prefer a 95 to 110 degree nasolabial angle in women and approximately 90 to 95 degrees in men. The surgeon should be aware that a nose with a high dorsum without a supratip break will appear less rotated than one with a low dorsum and a supratip break, even though the degree of rotation is the same. For this reason the amount of desired rotation should not be decided until the proposed dorsal profile line is determined. In a short person the nose may be slightly more rotated than in a tall person.



The columellar-lobular angle is formed by the junction of the columella with the infratip lobule and is approximately 30 to 45 degrees. Increased fullness in this area, usually caused by a prominent caudal septum, will give the appearance of increased rotation even though the nasolabial angle (the angle of rotation) is within normal limits.

The degree of tip rotation is evaluated based on the degree of the nasolabial angle. A decreased nasolabial angle indicates the need for increased tip rotation.

SYSTEMATIC NASAL ANALYSIS

Systematic nasal analysis plays a key role in achieving nasofacial harmony after rhinoplasty. This system allows for systematic and comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.[1]

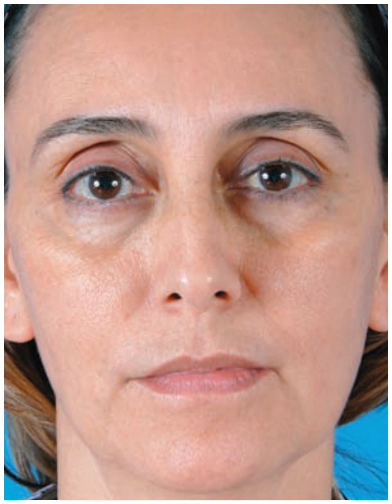
Systematic Nasal Analysis

Frontal View
Facial proportions
Skin type/quality—Fitzpatrick type, thin or thick, sebaceous
Symmetry and nasal deviation—midline, C-, reverse-C-, S- or S-shaped deviation
Bony vault—narrow or wide, asymmetrical, short or long nasal bones
Midvault—narrow or wide, collapse, inverted-V deformity
Dorsal aesthetic lines—straight, symmetrical or asymmetrical, well or ill defined, narrow or wide
Nasal tip—ideal/bulbous/boxy/pinched, supratip, tip-defining points, infratip lobule
Alar rims—gull shaped, facets, notching, retraction
Alar base—width
Upper lip—long or short, dynamic depressor septi nasi muscles, upper lip crease

Lateral View
Nasofrontal angle—acute or obtuse, high or low radix
Nasal length—long or short
Dorsum—smooth, hump, scooped out
Supratip—break, fullness, pollybeak
Tip projection—over- or underprojected
Tip rotation—over- or underrotated
Alar-columellar relationship—hanging or retracted alae, hanging or retracted columella
Periapical hypoplasia—maxillary or soft tissue deficiency
Lip-chin relationship—normal, deficient

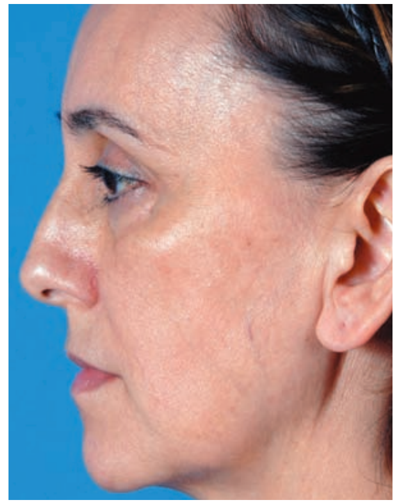
Basal View
Nasal projection—over- or underprojected, columellar-lobular ratio
Caudal septal deviation
Nostril—symmetrical or asymmetrical, long or short
Columella—septal tilt, flaring of medial crura
Alar base—width
Alar flaring

Systematic nasal analysis allows for comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.

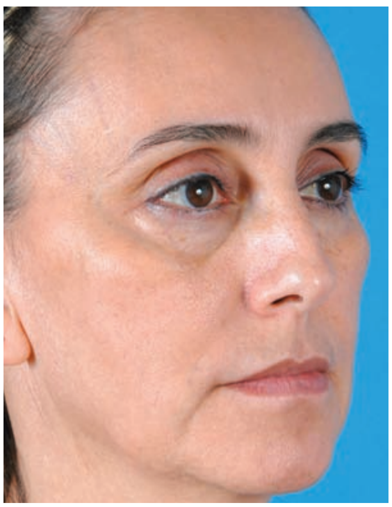


Anterior

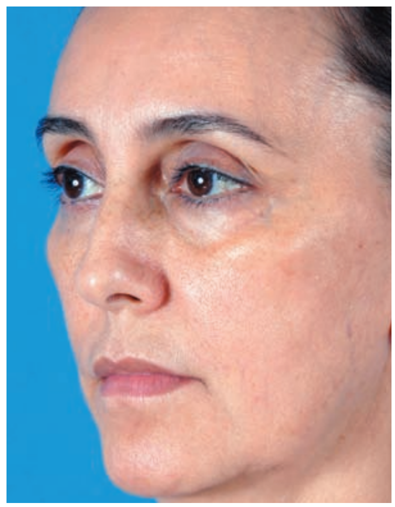
Right lateral



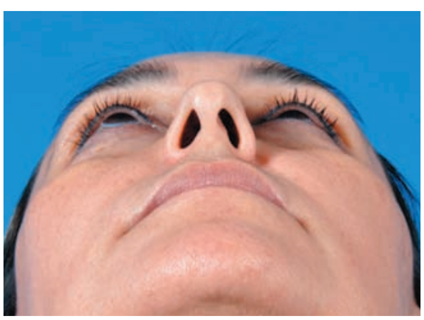
Left lateral



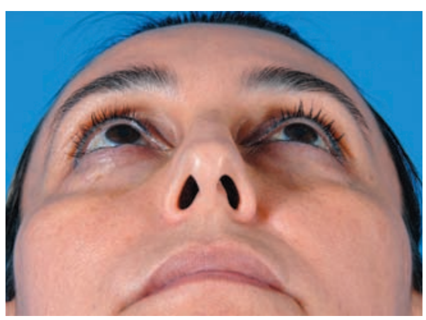
Right oblique



Left oblique



High basal



Low basal

Overhead

Standardized photography including frontal, lateral, oblique and basal views, should be obtained for every patient. These photos are a critical component for preoperative planning and evaluation of postoperative results. In addition, these photos are an essential element of the medical record. Standardized photography is discussed in detail in Chapter 7.

Systematic nasal analysis begins by examining facial proportions and skin characteristics. Next, nasal analysis is performed sequentially evaluating frontal, lateral and basal views. Finally, examination during smiling may reveal decent of the nasal tip, shortening of the upper lip, or a transverse crease in the midphiltral area which may benefit from depressor septi nasi muscle release or dissection and transposition.

CASE ANALYSES

On the frontal view, this patient has ideal facial proportions and Fitzpatrick type II, thin, acne prone skin. She has S-shaped deviation of her nasal dorsum with asymmetric dorsal aesthetic lines and left midvault collapse. She has a large, ill-defined nasal tip with wide tip-defining points.

On the lateral view, this patient has a low radix, moderate dorsal hump, and supratip fullness. She appears to have adequate tip projection but her tip is underrotated. Her columellar-labial angle is decreased while her columellar-lobular angle is increased.

On the basal view, she has a boxy tip, faceting of her soft triangle, nostril asymmetry, and flaring of the medial crural footplates.

On the frontal view, this patient has ideal facial proportions and Fitzpatrick type II, thin skin.[13] She has a reverse-C shaped deformity of her nasal dorsum with asymmetric dorsal aesthetic lines, and midvault collapse. She has an inverted-V deformity of the nasal dorsum. Her nasal tip is ill-defined and deviated to the left. She has asymmetry of her nostrils with her caudal septum or medial crural footplate visible in her left nostril.

On the lateral view, this patient has a large dorsal hump with supratip fullness. She has an overprojected, tension tip with decreased columellar-lobular angle, blunting of the columellar-labial angle, and shortening of her upper lip. Her chin is slightly deficient.

On the basal view, she has an overprojected tip with a 3:1 columellar to lobular ratio. She has severe caudal septal deviation. She has faceting of her soft triangles, and long, asymmetric nostrils due to her caudal septal deviation and medial crural footplates. She has a narrow alar base secondary to her overprojected tip.

On the frontal view, this patient has ideal facial proportions and Fitzpatrick type III, thick, oily skin.[14] He has a reverse-C-shaped deformity of the nasal dorsum with deviation of his tip to the right. The bony vault is wide. His nasal tip is large and ill-defined with an excess infratip lobule. This exaggerates the plunging nature of the tip and gives his nose an elongated appearance.

On the lateral view, this patient has a moderate dorsal hump with supratip fullness. He has an underrotated tip with an acute columellar-labial angle. His chin is slightly deficient.

On the basal view, he has adequate tip projection but the tip is mildly bulbous. He has flaring of the medial crural footplates and a wide columellar base.

KEY POINTS

- The facial skeleton should be evaluated for deformities such as maxillary or mandibular hyperplasia and hypoplasia, periapical hypoplasia, and malar prominence or recession. Adjunctive procedures such as orthognathic surgery, piriform aperture augmentation, or malar augmentation may be considered.
- The upper lip should be evaluated for position and contour; specifically, a tension lip can be associated with an overprojecting nose as well as an underprojecting nose. The rhinoplasty procedure can be designed to help decrease the tension lip appearance.
- Pseudorotation is observed when there is a prominence of the posterior caudal septum, which provides fullness in the columellar-labial junction.
- The thickness of the skin should be evaluated because thick skin will not drape over the reconstructed osteocartilaginous framework as well as thinner skin

and will be edematous for a longer period. When thin skin redrapes over the osteocartilaginous framework, it is more likely to show deformities than thick skin.

- The width of the bony vault of the nose should be 80% of the width of the nose at the alar bases, assuming the width at the alar bases is normal.
- The alar base width should approximate that of the intercanthal distance and palpebral fissure width.
- The tip is evaluated by locating the tip-defining points on each side, the point of the supratip break, and the columellar-lobular angle. Any discrepancy in the two equilateral triangles formed by these points should be evaluated to determine the cause.
- On the basal view the nose should form an equilateral triangle. The ratio of the columellar to the lobular portion of the nose should be 2:1, and the nostrils should be teardrop shaped.
- On the profile view, the deepest portion of the nasofrontal angle should lie between the upper eyelash line and the supratarsal fold with the eyes in forward gaze. An abnormal position may give the appearance of a long or shortened nose.
- For evaluating tip projection, a vertical line should be drawn adjacent to the most projecting part of the upper lip, and at least 50% to 60% of the tip should lie anterior to this line. This assumes that the upper lip has normal projection. The length/projection ratio should be 1:0.67.
- After the desired tip projection has been determined, the nasal dorsum is evaluated to see if reduction or augmentation is indicated.
- The degree of tip rotation is evaluated based on the degree of the nasolabial angle. A decreased nasolabial angle indicates the need for increased tip rotation.
- Systematic nasal analysis allows for comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.

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7

Digital Imaging and Standardized Photography in Rhinoplasty

Paul N. Afrooz ▪ Bardia Amirlak

High-quality, standardized imaging is an integral part of rhinoplasty planning, communication, execution, and mastery. Standardized imaging serves to identify the anatomy while providing the opportunity to encourage open patient-surgeon communication. Furthermore, rhinoplasty is a technically challenging procedure, the results of which are often measured by millimeters. As such, high-quality, standardized imaging facilitates critical analysis of postoperative results, thus fostering further mastery of this challenging operation.

Surgeons began to incorporate techniques of digitized photography into their practice as early as 1986.[1] Since that time, digital imaging has rapidly evolved and today has significant impact in plastic surgery. One of the many benefits of digital photography is that it allows surgeons to obtain immediate feedback from a rapidly generated image. This immediacy facilitates education of and consultation with patients as well as education of residents. Images can be inspected to identify those that are less than ideal and the process repeated until the desired image is obtained. This promotes standardization and eliminates the costs and time associated with film development. The user-friendly ability to store, organize, copy, share, edit, and import images into programs reduces the considerable storage and care costs associated with physical photographs. In addition to many educational, research, and marketing applications, photographic documentation also serves a medicolegal function.[2-4]

PHOTOGRAPHY BASICS

Cameras and Lenses

To capture an image, an appropriate amount of light strikes the medium onto which the image is being recorded. This medium can be a digital sensor chip or the more traditional silver-based film. In digital photography, the most widely used sensor is the *charge-coupled device* (CCD). The CCD is composed of individual light-sensitive electrodes that represent a pixel in the final image.[5] Light travels through the lens and strikes the electrodes to generate an electric signal. This signal strength is proportional to the amount of light that strikes each electrode. A digital converter converts the signal into digital form, which is then processed by the camera's microprocessor and displayed as a color image. The CCD itself is not sensitive to color; therefore only a black-and-white image is created. The individual color filters over each electrode allow the processor to produce a color image.[5-8]

When light enters through the lens of the camera, it passes through a *diaphragm*. In a digital camera, the diaphragm functions as both a *shutter* and an *aperture regulator.* The *shutter speed* controls the amount of time that light strikes the recording medium. *Aperture diameter* (D) refers to the diameter of the adjustable diaphragm of the lens, which determines the amount of light that falls onto the medium, much like the iris of the eye. Together, the aperture diameter and shutter speed control the amount of light that strikes the recording medium, thus determining the *exposure*.

Shutter speed is generally measured in fractions of a second (1/250 sec, 1/500 sec, or 1/1000 sec). The *focal length* (f) is the distance in millimeters from the optical center of a lens to the focal point located on the film or digital sensor. *Focal ratio, f-number,* or *f-stop* (N) is the ratio of the lens's focal length to the aperture ($N = f/D$). Because f-numbers are fractions of the focal length, larger f-numbers represent smaller aperture diameters. The *depth of field* refers to the distance between the closest and farthest objects that appear in focus in the photograph. That is, objects within a certain range of distance behind or in front of the focal plane of the lens appear sharp according to the depth of field. Depth of field is affected by the aperture, subject distance, and focal length of the lens. The aperture can be adjusted to increase or decrease the depth of field; the smaller the aperture, the greater the depth of field. In contrast, a large aperture has a shallow depth of field, making objects behind or in front of the focal plane blurry.

Camera lenses are categorized as *normal/standard, telephoto,* and *wide-angle.* A standard lens does not magnify or diminish the size of an image and has a focal length approximately equal to the length of the diagonal measurement of the recording medium. For example, 43 mm is the length of the diagonal for 35 mm film (35 by 24 mm), and the closest focal length equivalent is a 50 mm lens, which is considered the accepted standard lens. Currently, discrepancies exist between 35 mm film and the size of digital sensor chips, but digital sensors are being developed that will allow the use of interchangeable lenses more freely without concern for converting focal length.[8,9] Lenses with a focal length that is shorter than the sensor's diagonal are considered *wide-angle,* whereas lenses with a focal length that is longer than the sensor's diagonal are considered *telephoto.* In contrast to *prime lenses,* which have a fixed focal length, *zoom lenses* are designed to have an adjustable focal length. However, zoom lenses create variability when standardization of clinical photographs is attempted.[8]

Barrel distortion is a lens effect that causes images to be spherized or inflated. The image on the left was taken with a 105 mm lens. The image on the right was taken with an 18 mm lens, and the face has a centrally full appearance. Barrel distortion is associated with wide-angle lenses and typically occurs at the wide end of a zoom lens. In a clinical scenario, this distortion can create a rounded and centrally bulging appearance.

The opposite effect is *pincushion distortion,* which is a lens effect that causes images to be narrowed at their center. The image on the left was taken with a 105 mm lens. The one on the right was taken with a 200 mm lens, and the face has a centrally pinched appearance. Pincushion distortion is associated with long or telephoto lenses, or the telephoto end of zoom lenses.[9]

For rhinoplasty patients, it is important to use a lens that provides the least amount of distortion with the greatest depth of field to ensure that the whole face is in focus.[10] Lenses recommended for rhinoplasty are known as *portrait lenses.* They are in the range of 90 to 105 mm in focal length and prevent barrel distortion that often occurs with shorter focal lenses. This photo was taken with a 105 mm portrait lens.[8,10,11]

Portrait lenses are recommended for rhinoplasty. They have a focal length range of 90 to 105 mm and prevent barrel distortion that often occurs with shorter focal lenses.

Flash and Lighting

Lighting is critical to the production of high-quality, standardized photographs in rhinoplasty. The brightness of the flash determines the f-stop, which can affect the depth of field. Proper use of the flash allows the best possible depth of field, whereas excessive flash can lead to inappropriate aperture settings that can result in poor color quality and images with a washed-out appearance. Variations in lighting arrangements, light sources, and light positions can have a dramatic effect on photographic results.

Lighting is critical to the production of high-quality, standardized photographs in rhinoplasty.

To demonstrate subtle external anatomy, including surface defects, contours of the tip and tip-defining points, shape and symmetry of the dorsum, and the appearance and position of the alar cartilages, photographic lighting must provide high-contrast detail of the anatomy and highlight texture and sharp lines of demarcation. An intense light source or sources such as studio strobe lighting, on-camera flash, ring flash, or twin flash without diffusion are used to obtain this definition. This is in contrast to the soft, even, diffused lighting desired for facial rejuvenation surgery.[11]

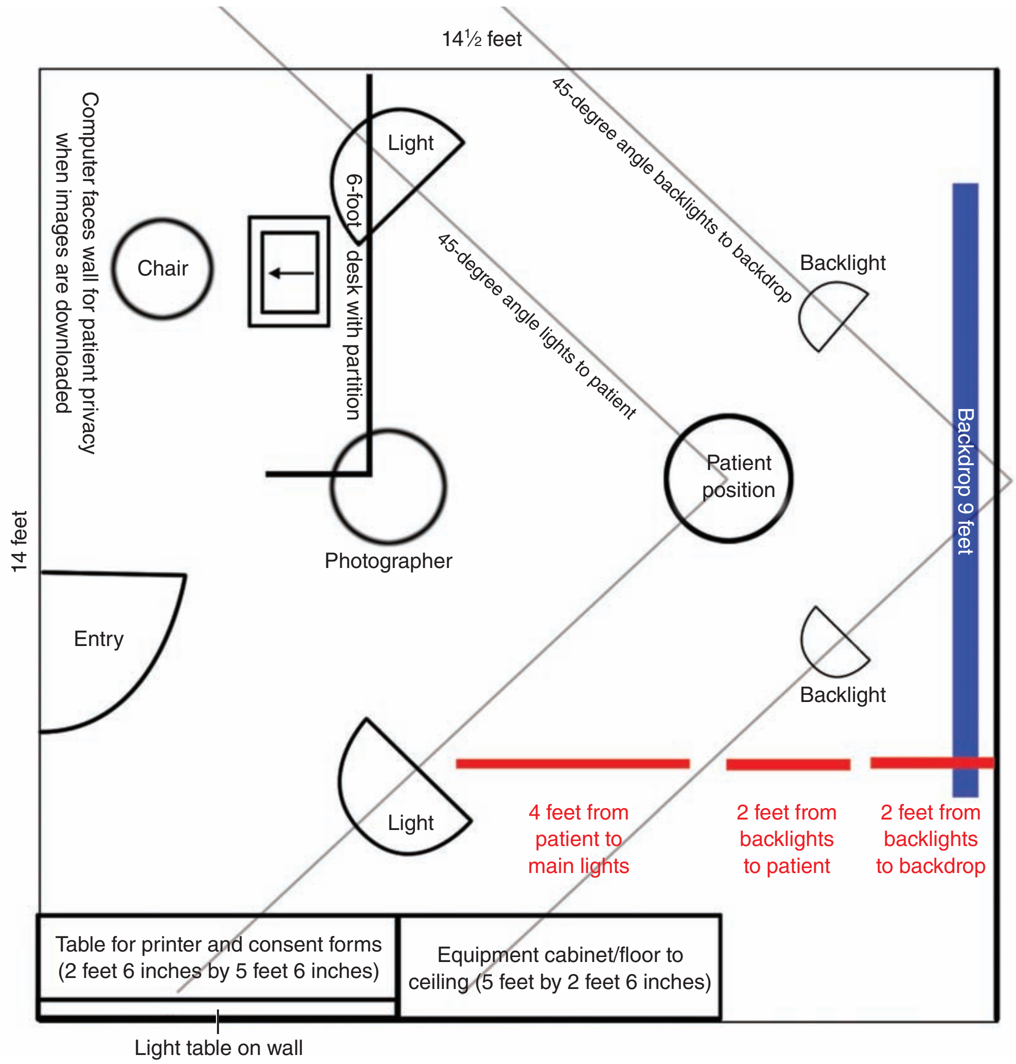
Although on-camera flashes have a tendency to create harsh shadows and uneven lighting, it is not always possible to have a dedicated photography studio with separate lighting. To optimize results with an on-camera flash, it is important to consider the position of the flash in relationship to the camera to eliminate shadowing. This is particularly important in rhinoplasty, because lateral

and oblique views are essential to the analysis. To prevent a projected shadow, the flash should be on the same side as the anterior part of the patient, effectively casting the shadow behind the patient. The image on the left (p. 115) was taken with the on-camera flash on the same side as the anterior part of the patient to cast the shadow behind the patient, whereas the image on the right does not have the appropriate flash orientation, resulting in significant shadowing of the patient's profile.

Ring flashes tend to create even, flat lighting that does not emphasize nasal anatomy. On-camera twin flashes are portable and simulate a studio flash system, but have a narrow flash distance.

The most common system for medical photography is the studio flash system.[11]

To prevent a projected shadow, the flash should be on the same side as the anterior part of the patient, effectively casting the shadow behind the patient.



Square photo room

For high quality and consistency in rhinoplasty photography, we advocate the quarter light system as a major studio system.[10,11] The quarter light system consists of two symmetrically sized lights placed at 45-degree angles to the patient-camera axis, with the patient 18 to 48 inches from the backdrop, depending on the use of backlighting. The use of a backlight or backlights is recommended to provide sharp contrast with the background and to further define nasal and facial anatomy.[11] The *horizontal angle of incidence* is the angle between the patient-camera axis and the flash. Ideally, this angle is 45 degrees.[10] Manipulation of this angle can have a profound impact on the appearance of nasal tip anatomy and tip-defining points. Therefore it is critical to maintain consistent light positioning.[12]

For high quality and consistency in rhinoplasty photography, we advocate the quarter light system as a major studio system.

Ideal lighting consists of a pure light source that produces predictable results. When a pure light source is used, the color temperature of the light source is known and correction can be accomplished with filters and white balancing settings. It is essential to minimize the number of light sources and compensate for their cast with white balancing to obtain accurate and reproducible color.[11]

DIGITAL PHOTOGRAPHY AND DIGITAL IMAGING SETUP

The quality, resolution, and convenience of digital photography have made it the standard in most rhinoplasty surgeons' practices today. The ability to eliminate the cost of film development and the physical storage space for prints and slides has been a major factor in the movement toward digital technology.

Space and Background

Although not always possible, having dedicated studio space improves efficiency, consistency, and patient privacy. Ideally, this space should measure at least 6 by 8 feet, and the walls should be a neutral color such as soft white. External light from windows should be blocked. Most experts agree that a medium or light blue tone is ideal for the background, because these colors are nondistracting and generally complement all skin tones. Furthermore, blue facilitates separation from the background for patients with dark hair and dark complexions.[13]

Most experts agree that a medium or light blue tone is ideal for the background, because these colors are nondistracting and generally complement all skin tones.

Memory Card

Memory cards function as digital film that can be reused thousands of times before being replaced. Rapid advances in technology have made digital images easy to store, transfer, and copy with diminishing cost. These images can be printed and used in the operating room as a reference for the operative plan and the desired aesthetic goals. Furthermore, images can be readily accessed for resident education, presentations, and consultation with colleagues. With proper imaging software, postoperative simulations can be created to facilitate patient consultation and define the aesthetic goals.

Cameras

The digital point-and-shoot and the digital single-lens reflex (DSLR) cameras are the two principal types of digital cameras on the market today. DSLR cameras use interchangeable lenses and can accommodate top-mounted flashes. Additionally, with a DSLR camera, photographers can use manual controls and fixed focal length lenses, which make the DSLR camera optimal for the production of standardized photographs.[8,9]

Digital cameras are stratified by their quantity of megapixels. A higher number of megapixels translates into greater resolution, which is the amount of detail in an image. Therefore more megapixels will lead to greater resolution and better image quality, and the size of the pixels contributes to the resolution. Although digital point-and-shoot cameras and DSLR cameras can have the same number of megapixels, the DSLR will generally have larger pixels. These larger pixels gather more light, creating an image with greater tonal range and resolution.[8,9]

Digital Imaging Software

Most operating systems today come with software for basic needs of storage, viewing, and editing images. However, several additional applications offer advanced features for viewing, archiving, and retrieving images. In addition, specialty software is available that allows surgeons to morph images to simulate operative changes.

Organization is essential for storing digital images. For each patient, an individual file should be maintained. Several advanced programs are available that allow searchable key words to be attached to images, including diagnosis, procedure, demographics. Examples include Mirror by Canfield Scientific, Inc. (Fairfield, NJ), Portfolio by Extensis (Portland, OR), Apple iPhoto (Cupertino, CA), and ACDSee (ACD Systems, Seattle, WA).[9]

PHOTOGRAPHIC STANDARDS IN RHINOPLASTY

Standardized, high-quality photographs of the nose are imperative for preoperative planning, postoperative comparison, and demonstration of surgical results. This calls for standardized lighting, proper patient positioning and views, prevention of lens distortion, and consistent camera-to-subject distances.[11]

Focus

To achieve reproducible, standardized photographs, the use of a set distance is recommended rather than autofocus. The camera's position can be manually adjusted to obtain a sharp focus. The *reproduction ratio,* which is the scale to which the photograph renders the subject, can also be used to obtain consistent results. Patients tend to vary in size; therefore using a standard subject-to-camera distance will not provide consistent anatomic pictures. Anatomic framing can be used to overcome this problem and achieve consistency. This is done by framing the subject, using the hairline superiorly and the sternal notch or thyroid cartilage prominence inferiorly. Some authors emphasize placing a ruler at the side of the face as an index of magnification to obtain life-size photographs for accurate definition of the aesthetic goals and surgical planning.[14]

Focal Point

In determining the focal point, it is often easiest to use definitive structures with sharp lines such as the eye. The use of a high aperture setting to create a large depth of field with focus on the eye is recommended. The subject is then adjusted in the frame after focusing is completed. If autofocus is employed, the center circle focal point is locked on the eye, and the subject can then be reframed in the viewfinder.[11]

Photographic Anatomy

The goals of photo documentation for rhinoplasty patients are to define the existing nasal anatomy, the aesthetic goals, and the operative plan. Photo documentation must be thorough and include the following[11]:

- Nasal dorsum: Deviations, nasal bone height, width, and transition into the nasal tip
- Nasal tip: Tip shape, tip-defining points, height of the infratip lobule, alar-columellar relationship, and nasal base width
- Profile: Radix, dorsal height, dorsal irregularities, supratip break point, tip projection, nasal length, columellar-labial angle, columellar-lobular angle, alar-columellar relationship, and the position of the lateral crura
- Nasal base: Nostril size and symmetry, nostril-lobule ratio, nasal width, columellar width, alar width, alar position, soft tissue triangle, and scars from previous open rhinoplasties
- Full face view: Relationship of the nose to other facial features

Standard Views for Rhinoplasty Photography

The six standard views necessary to critically evaluate nasal anatomy and the underlying nasal framework are the frontal, profile (left and right), oblique (left and right), and basal views. Although some variations in positioning are preferred for the oblique and basal views, it is important to maintain consistency when obtaining these images. For additional analysis, dynamic views can be obtained to assess the dynamics of the nasal tip and alar base during smiling, and the cephalic view to further highlight existing deviations.

The six standard views necessary to critically evaluate nasal anatomy and the underlying nasal framework are the frontal, profile (left and right), oblique (left and right), and basal views.

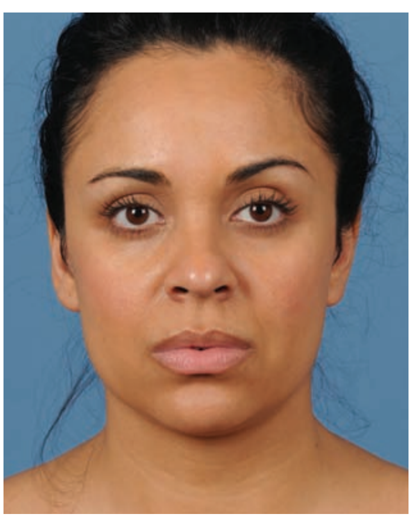
Head Position

To standardize views, careful attention must be given to head position, because changes can affect the appearance of the nose.[15] All jewelry and makeup should be removed.[16,17] The patient should be relaxed with no facial expressions, except in the smiling views.

The patient needs to look straight ahead with the head positioned in the natural horizontal facial plane. Gaze is directed at a fixed object in the room that is located at eye level to maintain consistency. The position of the earlobes with respect to the base of the nose should be noted. This can help to determine head tilt or rotation when comparing photographs. Subtle changes in head rotation and tilt can mask asymmetries if they are not recognized.[11,18]

Some authors advocate use of the Frankfort horizontal plane to standardize head position. However, in patients with low-set ears, this reference plane can cause the chin to appear weak and create the illusion of a more acute nasolabial angle. When using the Frankfort horizontal plane to determine head position, an additional point of reference can be obtained by placing an easily removable sticker or marker at the level of the infraorbital rim (red dot) to define the true Frankfort horizontal plane.[14]

Frontal View



For the frontal view, the patient should look straight into the lens. The head is in the natural horizontal facial plane with the camera at eye level. The patient is anatomically framed using the top of the hairline as the superior border and the thyroid cartilage prominence as the inferior border. Reproduction ratios of 1:10 for full face views or 1:4 for close-ups are recommended.[11]

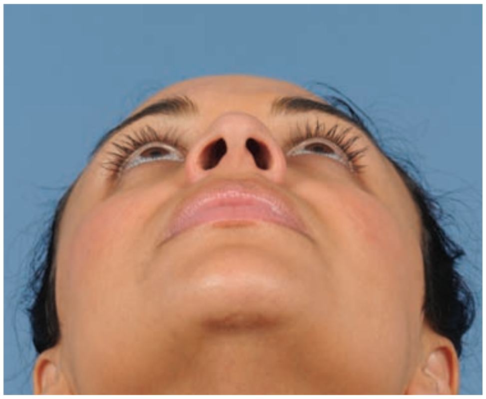
Lateral View

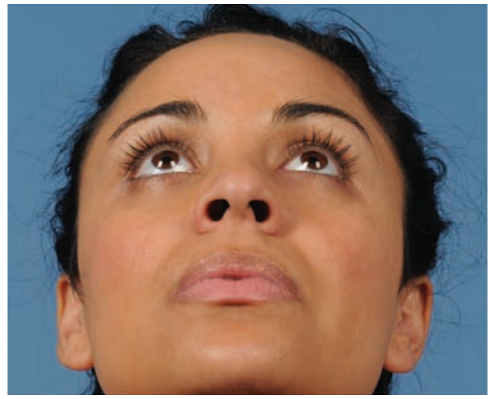
The lateral view is obtained with the patient looking straight ahead and the head positioned in the natural horizontal facial plane.

Oblique View

The oblique view can aid in further characterizing asymmetries of the dorsum and supratip area. The patient is turned to line up the tip of the nose with the lateral cheek, or to line up the dorsum with the medial eye.

Basal View





The basal view can be obtained using the full basal view or the half basal view. The head is tilted back, and the head and chin make up the anatomic frame superiorly and inferiorly, respectively. In a full basal view, the tip is lined up between the eyebrows. In the half basal view, the nasal tip is lined up with the medial canthi. These views provide information on nasal base width and symmetry, nostril size, and tip width. Characteristics of the dorsum can also be highlighted in the half basal view.

Cephalic View

The cephalic or overhead view can highlight subtle external nasal deformities and reveal deviations that are not obvious on frontal view. In this view, the eyebrows are used to align the patient horizontally.[19]

Smiling Frontal and Lateral View

The dynamics of smiling produce several changes in the anatomic relationships of the nose, particularly the relationship of the tip and alar base. The smiling frontal and lateral views highlight these changes and can help to identify an overactive depressor septi nasi muscle. This can cause excessive tip and alar base movement, resulting in a displeasing appearance.

THREE-DIMENSIONAL IMAGING

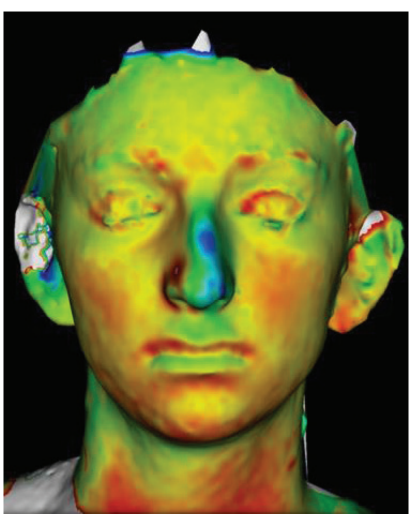
Currently, most rhinoplasty analysis is carried out using direct measurements of two-dimensional photographs in the frontal, lateral, oblique, and basal views. However, the nose is a three-dimensional structure, and subtle irregularities can be difficult to visualize in two dimensions, particularly in the frontal view.[20]

Variations in lighting and positioning with two-dimensional imaging can lead to inconsistencies, including changes in the appearance of tip-defining points.[12] Despite the implementation of standardized protocols, a change of photographers can cause significant variations in image acquisition and interpretation. Furthermore, lenses typically used for rhinoplasty imaging (90 and 105 mm) provide maximum depth of field to ensure that the whole face is in focus, but these lenses can potentially distort the image.[9,20]

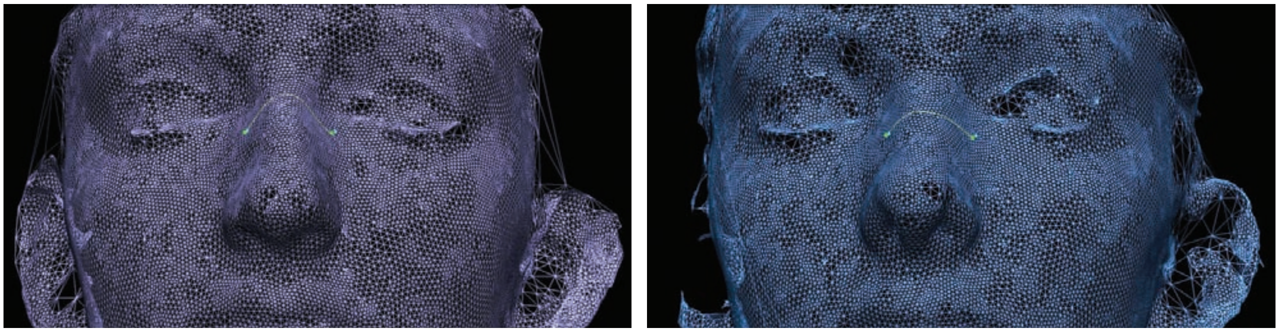
To obtain absolute measurements with two-dimensional images, photographs may require recalibration to actual life size with the use of manual measurement tools such as rulers or calipers, and measurements of known distances in the two-dimensional image.[14] Many of these obstacles can be overcome with three-dimensional imaging that employs linear and spatial parameters in a precise manner to outline the shape of the nose. These images are reproducible and maintain the proportions of the face independent of technique, photographer, camera, and lighting.

In general, three-dimensional systems consist of an optical system, a computer, and analytic software. Several forms of three-dimensional imaging modalities have been developed for anatomic study. CT, three-dimensional ultrasonography, Moiré topography, laser scanning, and stereophotogrammetry are a few of these techniques.[20] By far, stereophotogrammetry is the safest and most commonly used three-dimensional imaging modality that does not require laser beams and radiation. This involves taking multiple synchronous photographs with cameras at various angles. These images are then digitally merged to generate a three-dimensional image. Examples of these commercial imaging modalities available today include Vectra 3D (Canfield Scientific, Inc.) and 3dMD System (3dMD Inc., Atlanta, GA). These machines are easily placed in a small room in the office and do not require special lighting. After the images are captured and uploaded, the key landmarks are selected on a three-dimensional model automatically or manually. Uploaded images are analyzed with special software, and image morphing and manipulation can be performed immediately with the patient. Various nasal parameters such as nasolabial angle, tip shape, dorsal height, nasal length, supratip break, alar shape, vertical and horizontal proportions, and nasal and facial symmetry can be assessed and manipulated either with the patient present or at a later time using the saved images. Unlike two-dimensional imaging software tools, the image can be rotated and the degree of alteration visualized in multiple planes in real time. Preoperative and simulated postoperative images can be saved and printed for the patient or for intraoperative use.

To verify alignment and fully conceptualize the operative changes, the software can alter the transparency of either the preoperative or postoperative images. Superimposition of these images allows precise evaluation of the operative changes.



The software can also calculate volume changes. This is done by color coding, which demonstrates areas of volume change by way of a color gradient.



Furthermore, rather than measure straight point-to-point distances, which is possible with two-dimensional photographs, the distances from point to point can be measured along the contour of the nose with three-dimensional imaging software. For example, postoperative changes in dorsal width performed via medial osteotomies or dorsal grafts on a stable, wide nasal base will not yield visible changes in a two-dimensional frontal image. However, with three-dimensional imaging the topographic change in distance can be measured. Therefore three-dimensional scanning can help in preoperative planning by providing the insight to anticipate the degree of resection necessary to achieve desired postoperative changes.

Facial analysis using three-dimensional imaging in conjunction with two-dimensional imaging may offer new potential for understanding and standardizing aesthetic proportions of the face and nose. Advanced imaging technology is evolving rapidly and has allowed the use of four-dimensional systems to create unprecedented, realistic facial animation (DI4D; Dimensional Imaging, Glasgow, Scotland). With this technology, angles and animations can be manipulated and measured after capture to aid in the analysis of the dynamic tip and the dynamics of nostril movement before and after rhinoplasty. Currently, these images take a long time to generate after capture, and more practical documentation of these movements can be obtained with videography.

INTRAOPERATIVE IMAGING

Intraoperative images are essential for preparation of peer-reviewed presentations, resident education, and self-assessment. Although the portability of a point-and-shoot camera offers convenience for intraoperative use, a DSLR is preferable and will produce the most consistent images. Advantages of the DSLR are compatibility with interchangeable lenses, and high-powered external flashes for close-up images and optimal illumination.[21]

Prime/fixed focal length macrolenses are preferred over zoom lenses for intraoperative photography. This allows all settings to remain constant except for fine focus when images need to be obtained rapidly during the procedure. A prime lens with a focal length between 60 and 110 mm is preferable.[21]

An externally mounted macroflash such as a ring flash can provide the portability, even lighting, and power necessary for intraoperative photography. Ring flashes are powerful enough to facilitate the use of a small aperture, thus increasing the depth of field and producing sharp close-up images.[21] It may be necessary to make minor adjustments to the shutter speed and lens aperture during an intraoperative photography session, particularly if shooting from various distances. *Bracketing,* which is the practice of taking two to three shots at different adjacent f-stop settings, is a helpful technique to ensure proper exposure.

Optimal intraoperative images are taken close up and framed with fresh surgical towels to provide a clean background. Care must be taken to keep the field free of blood, which absorbs a large amount of light and can affect exposure. The use of hooks and retractors helps to provide a clean background and is highly encouraged.[21]

DIGITAL IMAGING AND MORPHING

Morphing software can be an excellent tool for patient communication and education. Some examples of digital morphing software include Adobe PhotoShop (Adobe Systems, Inc., San Jose, CA) and Aperture (Apple, Inc., Cupertino, CA). This allows a patient to point out areas of concern and communicate desired aesthetic goals. At the same time, the surgeon can educate the patient about realistic goals and limitations. It is extremely important to be cautious and judicious when using morphing software to avoid creating unrealistic expectations. Patients need to be informed that morphed images are merely a simulation and do not guarantee a result.[22] Moreover, surgeons should not generate imprudent or overzealous representations of postoperative outcomes. As is so often stated: “The surgeon must underpromise and overdeliver.” Communication facilitated by digital imaging can alert surgeons to patients who have unrealistic expectations and may help to discourage these patients from undergoing surgery.

It is extremely important to be cautious and judicious when using morphing software to avoid creating unrealistic expectations. Patients need to be informed that the morphed images are merely a simulation and do not guarantee a result.

▪ ▪ ▪

Communication facilitated by digital imaging can alert surgeons to patients who have unrealistic expectations and may help to discourage these patients from undergoing surgery.

LEGAL ISSUES

Clinical photographs have the potential to violate patient privacy. They are considered part of the medical record and are protected by federal laws such as the Health Insurance Portability and Accountability Act (HIPAA) and state privacy laws. Therefore it is critical to understand the legal and ethical issues involved before undertaking clinical photography. Consent should be obtained for all photographs and should include consent for publication and display[23] (see the sample consent form in Chapter 5). For publication in a journal, textbook, or Website, specific expressed consent for the particular publication should be obtained in addition to the standard consent form. Images published in these forums should be devoid of all patient information. As part of the medical record, patient photographs should not be destroyed, until after the legal medical record retention period as elapsed.[24] These images should be stored on a secure server with password protection compatible with institutional guidelines. Storage of images on personal computers that are not encrypted is highly discouraged.

If patient consultation includes digital imaging and morphing, it is imperative to counsel patients and ensure that they understand that the images are a simulation and in no way guarantee the actual surgical result. This information needs to be included on all morphed images given to a patient. To ensure image legitimacy and minimize image tampering, all images given to a patient should be authenticated with a time-date stamp or signature.[9,24]

It is imperative to counsel patients and ensure that they understand that digital images are simulations and in no way guarantee the actual surgical result. This information needs to be clearly stated on all morphed images given to a patient.

CONCLUSION

High-quality, consistent imaging is an essential tool for rhinoplasty surgeons. Standardized imaging fosters communication, education, documentation, planning, and mastery, thereby promoting patient and surgeon satisfaction alike.

ACKNOWLEDGMENT

We would like to thank the UT Southwestern Department of Plastic Surgery's Medical Photographers Patricia D. Aitson, Kara (Kate) M. Mackley, and Certified Medical Aesthetician Brandi Session for their time and expertise in the preparation of this chapter.

KEY POINTS

- Portrait lenses are recommended for rhinoplasty. They have a focal length range of 90 to 105 mm and prevent barrel distortion that often occurs with shorter focal lenses.
- Lighting is critical to the production of high-quality, standardized photographs in rhinoplasty.
- To prevent a projected shadow, the flash should be on the same side as the anterior part of the patient, effectively casting the shadow behind the patient.
- For high quality and consistency in rhinoplasty photography, we advocate the quarter light system as a major studio system.
- Most experts agree that a medium or light blue tone is ideal for the background, because these colors are nondistracting and generally complement all skin tones.
- The six standard views necessary to critically evaluate nasal anatomy and the underlying nasal framework are the frontal, profile (left and right), oblique (left and right), and basal views.
- It is extremely important to be cautious and judicious when using morphing software to avoid creating unrealistic expectations. Patients need to be informed that the morphed images are merely a simulation and do not guarantee a result.
- Communication facilitated by digital imaging can alert surgeons to patients who have unrealistic expectations and may help to discourage these patients from undergoing surgery.
- It is imperative to counsel patients and ensure that they understood that digital images are simulations and in no way guarantee the actual surgical result. This information needs to be clearly stated on all morphed images given to a patient.

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8

Postoperative Management of the Rhinoplasty Patient

Rod J. Rohrich ▪ Jamil Ahmad

Postoperative management of rhinoplasty patients is an important component of rhinoplasty and an extension of what was performed in the operating room.[1-7] Successful postoperative care begins in the preoperative period with a thorough review of the expected recovery with the patient. Patients should receive detailed written and oral postoperative instructions. Review of these instructions prepares patients for what is to be expected, clarifies and reinforces the details, minimizes anxiety, and helps involve them in their own care. A clear understanding of what activities are allowed and what restrictions should be followed in the postoperative period can help patients plan for the recovery period and may reduce the occurrence of certain complications.

Patients should receive detailed postoperative instructions before surgery. Review of these instructions prepares the patient for what is to be expected, clarifies and reinforces the details of the procedure, minimizes anxiety, and helps involve patients in their own care.

Dressings, medications, and management of complications are the key elements of the postoperative period. Our preferred postoperative management protocols are outlined in this chapter.

POSTOPERATIVE INSTRUCTIONS

All patients undergoing surgery receive both general postoperative instructions and postoperative instructions specific to the procedure that they are having. These instructions should be given to patients preoperatively so they have an opportunity to review them and prepare accordingly.

Patients should be given instructions as to when they should call their surgeon. Warning signs of potential emergencies should be reviewed. This includes both general problems such as fever nausea, vomiting, dizziness, shortness of breath, rash, rapid heartbeat and rapid breathing, and specific problems related to rhinoplasty including excessive pain at the surgical incisions and bleeding. Patients should be given specific instructions as to how to contact their surgeon and when to seek emergency medical treatment.

Patients are routinely prescribed pain medication, anxiolytics, sleeping pills, and antinausea medication. Postoperative instructions should describe when it is appropriate for the patient to take these medications. It is particularly important to instruct patients to keep the head elevated and to apply cold compresses to the eyes and cheeks frequently for the first 48 hours after surgery to decrease postoperative swelling, which is normal and may not reach its peak until 48 to 72 hours after surgery. When doing this, it is important not to saturate and/or apply significant pressure to the external splint, because this can lead to premature splint removal or displacement. Most of the postoperative edema will be resolved by 3 weeks. However, complete resolution of edema generally occurs 6 months to 1 year after surgery, and this is part of the normal recovery process. In addition, patients may notice increased edema when outside temperatures are warmer and with high salt consumption or after alcohol consumption. To avoid unnecessary anxiety and premature evaluation of the results, patients should be told—initially during the preoperative consultation and again as a reminder postoperatively—about the time necessary for complete resolution of edema.

Patients must be instructed to keep the head elevated and to apply cold compresses to the eyes and cheeks frequently for the first 48 hours after surgery. These measures are useful for decreasing postoperative swelling, which is normal and may not reach its peak until 48 to 72 hours after surgery.

Patients should be informed of activity restrictions, because these restrictions will often influence when they can return to their normal daily activities and to work. Strenuous activities and exercise should be avoided for at least 2 weeks after surgery. Normal activity should be gradually resumed starting 48 hours after surgery. Strenuous activity and heavy lifting of objects greater than 5 to 10 pounds should be avoided for 4 to 6 weeks after surgery. There should be no trauma or pressure on the nose for 6 weeks postoperatively.

Patients should be informed of activity restrictions, because these restrictions will often influence when they can return to their normal daily activities and to work.

Rod J. Rohrich, MD
Plastic Surgery

Rhinoplasty (Nasal Surgery)

AFTERCARE INSTRUCTIONS

- When sleeping, keep your head elevated on two pillows for the first 7 days after surgery.
- During the day for the first 72 hours after surgery, apply crushed ice in an ice bag or Swiss eye pads (obtained from the hospital) to minimize swelling and bruising. Do not put pressure on the nasal splint.
- It is normal to continue to swell after the first 48 hours. Swelling reaches its peak at 48 to 72 hours.
- If you have pain, take the pain medication every 4 to 6 hours. It is best to take it with crackers, Jell-o, etc. If you have no pain, do not take the medication. You should not use alcohol while you are taking a pain medication.
- If you feel anxious, take the antianxiety medication (Xanax) every 8 hours for the first 24 to 48 hours. *DO NOT TAKE THE SLEEPING PILL IF YOU TAKE XANAX.*
- After surgery, begin on that day with a light diet of liquids only. The next day you can begin a soft, regular diet but for 2 weeks avoid foods that require excess lip movement such as apples, corn on the cob, etc.
- You will probably have a bloody nasal discharge for 3 to 4 days, and you may change the drip pad under your nose as often as needed. Do not rub or blot your nose, because this will tend to irritate it. You can discard the drip pad and remove the tape on your cheeks when the drainage has stopped.
- To prevent bleeding, do not sniff or blow your nose for the first 2 weeks after surgery. Try not to sneeze, but if you do, sneeze through your mouth.
- While the nasal splint is on, you may have your hair washed beauty salon fashion. Take care to prevent the nasal splint from getting wet.
- Keep the inside edges of your nostrils and any stitches clean by using a Q-tip saturated with hydrogen peroxide followed by a thin coating of Polysporin ointment. This will help prevent crust from forming. You may advance the Q-tip into the nose as far as the cotton on the Q-tip, but no farther. You will not hurt anything inside your nose as long as you are gentle in your actions.

GENERAL POSTOPERATIVE INSTRUCTIONS

- Avoid strenuous activity (actions that increase your heart rate above 100 beats per minute [i.e., aerobics, heavy lifting, and bending over]) for the first 3 weeks after surgery. After 2 weeks you should slowly increase your activities so you will be back to normal by the end of the third week.
- Avoid hitting your nose for 4 weeks after surgery.
- After the splint is removed, do not wear glasses or allow anything else to rest on your nose for 4 weeks. Glasses should be taped to the forehead. (We will show you how.) Contacts can be worn as soon as the swelling has decreased enough for them to be inserted.
- The skin of your nose is sensitive to sunlight after surgery. Protect your nose from excessive exposure for 6 months. Wear a wide-brimmed hat and/or apply a good sunscreen (SPF-20 or greater) with both UVA and UVB protection if you have to be in the sun for prolonged periods.
- The nasal splint will be removed 6 to 7 days after surgery.
- After the nasal splint is removed, the nose can be washed gently with a bland soap, and makeup can be applied. Moisturizing creams can be used if the nose is dry.
- The tip of the nose will sometimes feel numb after rhinoplasty and occasionally the front teeth will feel “funny.” These sensations will gradually disappear.
- Much of the swelling will be gone 2 to 3 weeks after surgery. It often takes approximately 1 year for the last 10% of the swelling to disappear. Your nose may feel stiff when you smile and not as flexible as before surgery. This is not noticeable to others, and things will gradually return to normal.
- Take your medications carefully and only as directed.
- If you have nausea, vomiting, rash, shortness of breath, or diarrhea after taking your medications, or if you develop a fever (oral temperature greater than 101.3° F [38.5° C]), develop redness, or have increased pain at the site of your surgical incisions, *CALL THE OFFICE IMMEDIATELY.*

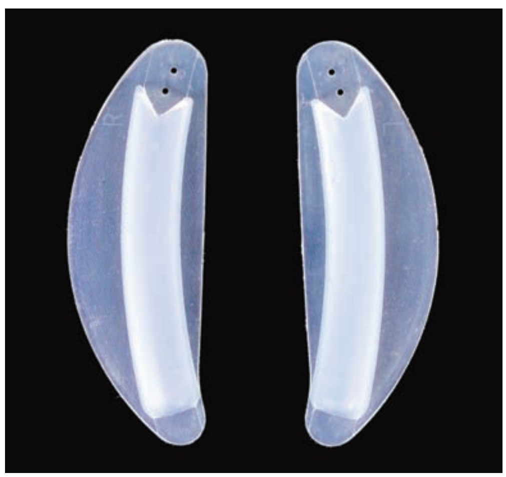
Continued

Rhinoplasty (Nasal Surgery)—cont'd

- After your sutures are removed and the internal/external splints are removed, it is recommended that you use a saline (salt water) solution (Ocean or Ayr Nasal Spray) to gently remove crusty formation from inside your nose, especially if you have had internal nasal surgery such as septal reconstruction or inferior turbinate resection.
- You can use nasal spray (Afrin) intermittently ONLY for the first and second week postoperatively for improved nasal breathing. If you are taking an airline flight, spray each nostril 30 minutes before takeoff and thirty minutes before landing to help prevent your ears/nose from popping.
- If you experience increased nasal bleeding with bright red blood (with a need to change your nasal pad every 30 to 40 minutes), notify the doctor immediately. You should sit up and apply pressure to the end of your nose for 15 minutes, and you can use Afrin spray to stop the oozing in the interim. Bleeding usually stops with these maneuvers.

DRESSINGS

Internal Splints and Packing



We prefer to use Doyle septal splints (Micromedics Inc., St. Paul, MN) in all patients undergoing septal reconstruction and/or turbinate surgery.

The goal is to avoid hematomas between the mucoperichondrial flaps, support and stabilize the septal structures in the midline, protect the mucosa, and prevent the formation of synechiae by apposition of adjacent mucosal surfaces. The splints are lubricated with antistaphylococcal antibiotic ointment and are inserted at the end of the operation. These internal nasal splints should be placed using a speculum under direct visualization to avoid damage and possible perforation of the mucoperichondrium. They are secured with a single through-and-through 3-0 nylon horizontal mattress suture tied loosely to avoid strangulation of the septum as the tissues swell in the postoperative period.

Internal nasal splints should be placed using a speculum under direct visualization to avoid damage and possible perforation of the mucoperichondrium.

The splints are removed in the office, generally 7 days after surgery. In patients who have undergone extensive septal reconstruction or repair of septal perforations, the splints may need to be left in place for longer periods (approximately 10 to 21 days). When nasal splints are left for this duration, the patient should gently inhale antibiotic ointment through the nose to keep the nasal airway and splints moist and well lubricated. Comfort is improved with hygiene, keeping the splints free of clot and mucous plugs to maintain a patent nasal airway. It is important to remove the internal splints before removing the external splint to prevent potential displacement of the osteotomies and/or rupture of sutures as the splints are extracted. Removal is facilitated by removal of the nylon suture, grasping the leading edge of the splint with a hemostat or toothed forceps, and asking the patient to breathe out through the nose as the surgeon gently pulls the splint out.

It is important to remove the internal splints before removing the external splint to prevent potential displacement of the osteotomies and/or rupture of sutures as the splints are extracted.

Nasal packing is generally unnecessary and is uncomfortable for the patient. However, it may be necessary in rare instances, such as to support a flap or graft, or for uncontrolled bleeding at the end of a procedure. Packing should be removed within 24 hours on the rare occasions it is used.

Nasal packing is generally unnecessary and is uncomfortable for the patient. Doyle septal splints are frequently used after septal reconstruction and/or turbinate surgery, because they stabilize septal structures in the midline, protect the mucosa, and prevent synechiae.

External Splints

External dressings consist of soft tissue taping and application of an external splint. At the completion of the procedure, the edema is compressed from the soft tissues of the lobule, and the skin is prepared with alcohol and skin adhesive. The soft tissues are taped with ¼-inch paper tape or Steri-Strips. Taping begins at the supratip break to drape the soft tissue in this location intimately to the underlying nasal skeleton. Strips of different lengths are then carefully applied transversely over the nose, without applying excessive pressure over the sculpted framework. An additional piece may be applied along the caudal aspect of the nasal lobule to provide support to the new tip.

A Denver Dorsal Splint (Shippert Medical Technologies Corp., Denver, CO) is shaped over a cylindrical object whose diameter is similar to the width of the dorsum and the osseous base of the nose.

As shown above, it is then carefully applied over the upper two thirds of the dorsum, and its edges are compressed medially to keep the osteotomized nasal bones in position. Overcompression of the nasal structures with the splint should be avoided, because this can lead to medial displacement of the osteotomized segments of bone. It is essential to keep the distal end of the splint cephalad to the supratip area. When extended over this area, the splint may distract the supratip skin away from the osteocartilaginous framework, creating a dead space that will be filled by scar tissue. This may compromise the end result because of loss of the supratip break and/or a supratip deformity. In our practice we have avoided this problem by using small-sized splints that simply do not extend onto the supratip area. Finally, a drip pad is secured under the nose with flesh-colored tape, secured to tape on the cheeks.

Overcompression of the nasal structures with the splint should be avoided, because this can lead to medial displacement of the osteotomized segments of bone.

The splint and tape are removed in the office after 5 to 7 days using a fine stylet. The stylet is inserted between the tape and the skin over the dorsum. Gentle side-to-side sweeping movements elevate the tape from the skin, allowing the splint to be removed without elevating the skin from the underlying osteocartilaginous framework. Use of the fine stylet minimizes the patient's pain and discomfort because virtually no pressure is applied onto the underlying framework during the removal process.

SUTURES

Columellar sutures (6-0 black nylon) are removed in the office after 5 to 7 days. Some or all of the alar base sutures may be left in place for up to 10 days. Fine-tip suture scissors or a No. 11 blade can be used to precisely remove these sutures. Internal nasal sutures are resorbable and do not require removal.

MEDICATIONS

For surgical site infection prophylaxis, an intravenous dose of cephazolin is given before incision and oral cephalexin is given as postoperative antibiotic prophylaxis for 24 hours.

Vitamins and supplements in general are encouraged as long as they do not cause excessive bleeding. We have patients stop using any anticoagulants including aspirin, fish oil, and flaxseed oil for 2 weeks preoperatively and 2 weeks postoperatively.

Pain medications are prescribed as needed. Patient discomfort with rhinoplasty is extremely variable and may be attributable to the degree of skeletal manipulation. Patients more commonly complain of congestion. Narcotics are used for the first several days and nonsteroidal antiinflammatory drugs (NSAIDs) are frequently sufficient thereafter. Constipation prophylaxis is important when narcotics are being used to prevent straining, which could cause postoperative bleeding.

Minimal postoperative pain medication is normally required after rhinoplasty. Antibiotic agents and steroids are routinely used preoperatively.

Nausea is not uncommon postoperatively because of the cathartic effect of swallowed blood. Nausea can be prevented or minimized by placing a moistened throat pack at the beginning of surgery and suctioning the oronasopharynx after the throat pack is removed. Intravenous odansetron (8 mg) is also given intraoperatively and continued for 24 hours postoperatively to prevent nausea and vomiting. Intravenous dexamethasone (8 mg) is administered preoperatively to help reduce postoperative nausea. A short course of oral methylprednisolone (Medrol Dose-Pak) can be given to help reduce postoperative edema although no conclusive data exists to show its efficacy.

Incision lines are gently cleaned three times daily using a cotton tip applicator to apply 3% hydrogen peroxide diluted to half strength in saline. This will facilitate easy removal of the sutures. Antistaphylococcal antibiotic ointment is applied to the incisions and nares for 2 or 3 days.

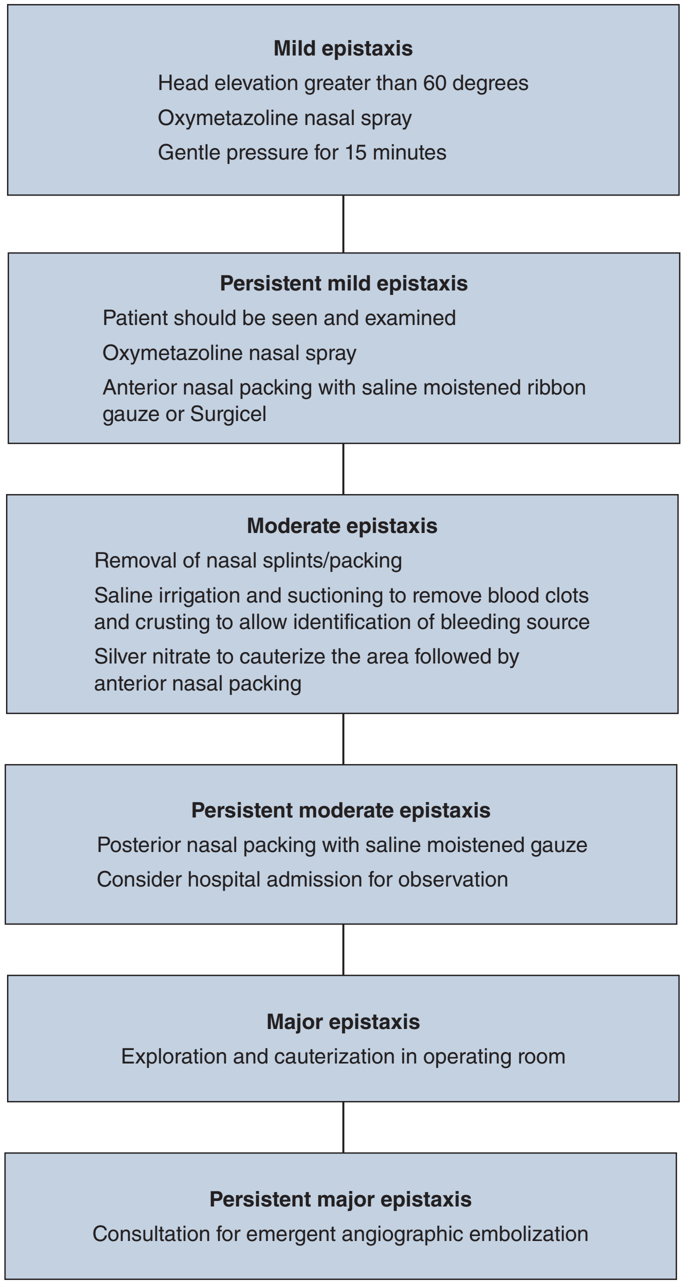
POSTOPERATIVE PROBLEMS

Bleeding/Hematoma

Light postoperative bleeding is not uncommon in the first 48 hours after rhinoplasty.[1,8,9] The patient can control it by elevating the head 60 degrees (to decrease venous pressure) and by spraying oxymetolazone topical solution into the affected nostril and gently applying pressure to the nostril for 15 minutes. This process may be repeated twice but if bleeding still persists, the surgeon must see the patient immediately to control the problem. Initially the surgeon will place an anterior nasal packing made of wet cotton or Surgicel lubricated with antibiotic ointment in the anterior nasal cavity.

In general, postoperative bleeding will be mild and can be controlled by elevating the head to 60 degrees and gentle nostril pressure for 15 minutes. This should be followed by spraying each nostril with oxymetazoline. If these measures fail, the patient should be seen. Cauterization with silver nitrate, anterior/posterior nasal packing, operative exploration and cauterization, and angiographic embolization (rare) may be required.

If these measures fail, the surgeon should remove the internal nasal splints and irrigate and suction the nasal cavity to remove blood clots and crusts. Cauterization with silver nitrate of offending areas followed by anterior packing of the nasal cavity is then recommended. If bleeding still persists, hospitalization and/or posterior packing is considered. Serious bleeding occurs in less than 1% of patients and must be addressed with operative exploration and cauterization. When



this occurs, it is usually after inferior turbinate resection. Bleeding that is refractory to all of these measures is best addressed with angiographic embolization.[1]

Postoperative hematomas require drainage, regardless of location. Septal hematomas can lead to septal perforations if untreated, and hematomas underlying the skin flap lead to fibrosis and deformation of the nasal appearance. Hematomas may be drained in the office using a fiberoptic light source as needed. The surgeon must carefully pack a ¼-inch gauze strip into the drainage site to prevent recurrence. It should be removed the following day.

Infection

Infection following rhinoplasty is very rare. Early signs of infection are typical of cellulitis and include tenderness, erythema, and warmth. Early cellulitis usually responds appropriately to cephalosporin antibiotic agents but all internal splints may need to be removed at this time. Infection refractory to this treatment may necessitate treatment with a quinolone or other antibiotic agent providing gram negative coverage and *Pseudomonas* coverage more specifically. Any purulent material or exudates should be cultured to guide antibiotic therapy. Purulent collections require drainage and irrigation. Toxic shock syndrome is extremely rare after rhinoplasty but has been reported with both nasal packing and internal nasal splints.[1] Nasal packing and/or internal nasal splints should be removed immediately, appropriate antibiotic treatment and supportive treatment should be started, and hospital admission is frequently required.

Purulent collections require drainage and irrigation.

Persistent Edema

Edema should be considered in two distinct postoperative phases: early and late. Early edema occurs within the first 4 weeks. Minimizing early edema is best addressed by prevention using cold compresses, head elevation, taping, and avoiding salt laden foods.

Late edema is that which is present over the following several months to the first postoperative year (or longer following secondary rhinoplasty) and actually represents scar remodeling. Persistent edema will therefore resolve on its own; the patient should be reassured about this. In certain situations steroid injections may be helpful to control the production of the excessive scar tissue that may occur in some areas of the nose, masking the result. The most common indication in our practice has been attenuation or loss of the supratip break, which is caused by the proliferation of scar tissue in the dead space between the skin and underlying osteocartilaginous framework, as seen in secondary rhinoplasty patients and in men with thick skin.[10,11]

In these patients, triamcinolone acetate (10 mg/ml) mixed with 2% lidocaine plain at a 1:1 ratio can be injected into the supratip area with a 27-gauge needle. These injections should be deep in a plane, just superficial to the perichondrium. Subdermal steroid injections should be avoided, because they can lead to hypopigmentation, tissue atrophy, and ulceration. Typically 3 to 5 mg of triamcinolone is delivered to the affected area per treatment. This may be performed

as early as 1 week postoperatively. Treatment may be repeated at 4- to 6-week intervals, depending on the clinical picture.

Steroid injections may be required to treat persistent edema and should be deep in a plane just superficial to the perichondrium. Subdermal steroid injections should be avoided, because they can lead to hypopigmentation, tissue atrophy, and ulceration.

The dose, volume, and frequency of injections should be limited to avoid overtreatment leading to subdermal atrophy. This may result in unsightly contour deformities, translucency of the epidermis, and visibility of the underlying cartilages.

Taping of the soft tissues is an effective treatment for both early and late edema. After removal of the initial dressing, patients are instructed to apply Blenderm surgical tape (3M, St. Paul, MN) to the supratip area for several hours overnight. This prevents accumulation of edema when the patient is recumbent while sleeping and helps to mold the soft tissues in the supratip area when needed. This may be interrupted when a permanent depression is generated in the supratip area. Taping is particularly useful in the first week or two after the dorsal splint is removed. Alternatively, the nasal dorsum may be taped using Steri-Strips from the supratip to radix immediately after removal of the external splint and this tape can be left in place for another week. If the tape causes skin irritation, its use should be discontinued, and the patient should apply hydrocortisone cream three times a day until the irritation resolves.

Taping to control soft tissue edema is particularly useful in the first week or two after removal of the dorsal splint.

Dorsal Irregularity/Deviation

Occasionally, dorsal irregularities or deviations will occur in the postoperative period. The patient is examined to determine the cause and severity. Palpation of the dorsal irregularity may reveal displacement of cartilage, bone or grafts and it may be possible to correct this with digital repositioning of the structure. Minor fullness at the keystone area may develop in the first few weeks following rhinoplasty and may be due to a periosteal inflammatory reaction. In this case, the patient is instructed to massage the area in a very controlled manner to help prevent the formation of scar tissue and periosteal thickening at the keystone area.

Mild irregularities are observed for the first year. Those that persist and remain objectionable are corrected operatively. Significant early postoperative irregularities should be corrected immediately because they will not improve. This early intervention will help prevent unnecessary patient distress and dissatisfaction.[12]

Significant early postoperative irregularities should be corrected immediately because they will not improve. This early intervention will help prevent unnecessary patient distress and dissatisfaction.

Dorsal deviations are treated similarly. Deviations noted in the early postoperative period may be corrected with manual pressure. Significant deviations in the early postoperative period may require early operative intervention. Late presenting deviations will require operative intervention after allowing 1 year for resolution of edema and scar maturation.

Nasal Airway Obstruction

Nasal airway obstruction in the postoperative period is either secondary to edema or anatomic.[13] Most patients have some degree of transient airway obstruction that will resolve over 2 to 3 weeks. It is difficult to perform internal examination of the nose before 3 weeks because it causes patient discomfort; the surgeon must reassure the patient that the obstruction should resolve. When the obstruction persists, the surgeon should examine the patient with and without topical vasoconstrictors to determine the cause of obstruction. Obstruction secondary to edema is monitored. In many instances, the patient will notice improvement of their symptoms secondary to edema and mucosal hyperreactivity by using saline nasal spray two or three times per day. Nasal decongestants may be used if symptoms are significant but topical agents should not be used for more than 5 to 7 days because of rebound effects of the medication. Maximal recovery of nasal airflow should occur between 3 to 4 months after rhinoplasty. Anatomic obstruction requires surgical intervention but this should be delayed for at least 1 year to allow for scar tissue maturation. The most common anatomic cause is internal nasal valve collapse or scarring in the internal nasal valve area.

POSTOPERATIVE FOLLOW-UP

Patients return for follow-up visits at 1 week, 3 weeks, 6 weeks, 6 months (postoperative photographs are taken at this time), 1 year, and then every 1 to 2 years for evaluation of long-term results.

It is particularly important to recognize patients' concerns and anxiety in the early postoperative period. Many patients requesting rhinoplasty have expectations of how they will look after their surgery, but because of swelling and bruising, it may be several weeks after surgery before patients can really begin to appreciate the changes to their appearance. It is essential to provide support during this interval and reassure patients that what they are seeing is a normal part of the recovery process.

It may take some time before patients can really begin to appreciate the changes following rhinoplasty. During this time, patients require support and reassurance that what they are seeing is a normal part of the recovery process.

KEY POINTS

- Patients should receive detailed postoperative instructions before surgery. Review of these instructions prepares patients for what is to be expected, clarifies and reinforces the details of the procedure, minimizes anxiety, and helps involve patients in their own care.
- Patients must be instructed to keep the head elevated and to apply cold compresses to the eyes and cheeks frequently for the first 48 hours after surgery. These measures are useful for decreasing postoperative swelling, which is normal and may not reach its peak until 48 to 72 hours after surgery.
- Patients should be informed of activity restrictions as these restrictions will often influence when they return to their normal daily activities and also when they return to their work.
- Nasal packing is generally unnecessary and is uncomfortable for the patient. Doyle septal splints are frequently used after septal reconstruction and/or turbinate surgery because they stabilize septal structures in the midline, protect the mucosa and prevent synechiae.
- Internal nasal splints should be placed using a speculum under direct visualization to avoid damage and possible perforation of the mucoperichondrium.
- It is important to remove the internal splints before removing the external splint to prevent potential displacement of the osteotomies and/or rupture of sutures as the splints are extracted.
- Nasal packing is generally unnecessary and is uncomfortable for the patient. Doyle septal splints are frequently used after septal reconstruction and/or turbinate surgery because they stabilize septal structures in the midline, protect the mucosa and prevent synechiae.
- Overcompression of the nasal structures with the splint should be avoided, because this can lead to medial displacement of the osteotomized segments of bone.

- Minimal postoperative pain medication is normally required after rhinoplasty. Antibiotic agents and steroids are routinely used preoperatively.
- In general, postoperative bleeding will be mild and can be controlled by elevating the head to 60 degrees and gentle nostril pressure for 15 minutes. This should be followed by spraying each nostril with oxymetazoline. If these measures fail, the patient should be seen. Cauterization with silver nitrate, anterior/posterior nasal packing, operative exploration and cauterization, and angiographic embolization (rare) may be required.
- Purulent collections require drainage and irrigation.
- Taping to control soft tissue edema is particularly useful in the first week or two after removal of the dorsal splint.
- Steroid injections may be required to treat persistent edema and should be deep in a plane just superficial to the perichondrium. Subdermal steroid injections should be avoided, because they can lead to hypopigmentation, tissue atrophy, and ulceration.
- Significant early postoperative irregularities should be corrected immediately because they will not improve. This early intervention will help to prevent unnecessary patient distress and dissatisfaction.
- It may take some time before patients can really begin to appreciate the changes following rhinoplasty. During this time, patients require support and reassurance that what they are seeing is a normal part of the recovery process.

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9

Coding of Reconstructive and Cosmetic Rhinoplasty Procedures

Raymond V. Janevicius

Although CPT coding for nasal procedures is relatively straightforward, confusion may arise on various fronts. Some inconsistencies are present in the CPT book, and precisely what constitutes a global code for rhinoplasty procedures is sometimes unclear. Overlap between reconstructive and cosmetic rhinoplasty often occurs, and distinguishing between cosmetic and reconstructive procedures is critical from a coding standpoint.

GENERAL CONSIDERATIONS

From a coding perspective, no distinction is made between open rhinoplasty procedures and endonasal procedures. These are considered "approaches," and the CPT book does not differentiate between the two. Codes are selected based on the procedures performed on the cartilage and bone. An incision in the columella is not separately reported, nor is the closure of this incision.

PRIMARY PROCEDURES

A tip rhinoplasty, whether for posttraumatic deformity or for purely cosmetic reasons, is coded 30400 if no other nasal procedure is performed (that is, no osteotomies or septal surgery).[1,2] Code 30400 is global and encompasses all components of a tip procedure, including cephalic trim and other cartilage excisions, cartilage suturing, cartilage repositioning, grafting, and scoring techniques. Code 30400 includes surgery on both alar cartilages, because it reads "nasal tip." Surgery on each alar cartilage should not be coded separately, nor should the bilateral modifier 50 be appended to this code.

Commonly Used CPT Codes for Nasal Surgery

30400	Rhinoplasty, primary; lateral and alar cartilages and/or tip
30410	Rhinoplasty, primary; bony pyramid, lateral and alar cartilages and/or tip
30420	Rhinoplasty, primary; bony pyramid, lateral and alar cartilages and/or tip, including major septal repair
30430	Rhinoplasty, secondary; minor revision (nasal tip)
30435	Rhinoplasty, secondary; intermediate revision (bony work with osteotomies)
30450	Rhinoplasty, secondary; major revision (nasal tip and osteotomies)
30460	Cleft lip rhinoplasty, including columellar lengthening; tip only
30462	Cleft lip rhinoplasty, including columellar lengthening; tip, septum, osteotomies
30465	Repair of nasal vestibular stenosis (for example, spreader grafting, lateral nasal wall reconstruction)
30520	Septoplasty or submucous resection with or without cartilage scoring, contouring, or replacement with graft
20912	Septal cartilage graft (septal donor site)
21210	Bone graft to nose (includes obtaining graft)
21230	Rib cartilage graft to nose
21235	Ear cartilage graft to nose
15760	Composite graft

Placement and positioning of a cartilage graft are included in code 30400, but harvest of the graft is separately reported. Septal cartilage harvested for a tip graft is reported with code 20912; costal cartilage harvest is reported with code 21230. Thus, a tip rhinoplasty with placement of a septal cartilage graft is coded:

30400	Tip rhinoplasty
20912-51	Harvest of septal cartilage

If surgery is performed on the bony pyramid in addition to the tip rhinoplasty, code 30410 is used alone. This code includes surgery on the tip as well as bony work. The tip work is not coded separately, because this is included in the global code 30410; that is, 30400 is not reported in addition to code 30410. Thus a rhinoplasty that includes a cephalic trim, dorsal reduction, and osteotomies is coded 30410.

Harvest of bone or cartilage grafts is reported separately. A rhinoplasty including surgery on the tip with a cranial bone graft to the dorsum is reported as:

30410	Rhinoplasty, tip and bony dorsum
21210-51	Bone graft

A septorhinoplasty is coded 30420. This code includes septoplasty/submucous resection, bony pyramid surgery, and tip surgery. Code 30420 is global and includes codes 30400, 30410, and 30520, which should not be reported in addition to code 30420. This would be unbundling.

Code 30420 includes harvest and placement of septal cartilage grafts but does not include harvest of bone grafts or *nonseptal* cartilage grafts. Thus a septorhinoplasty requiring dorsal augmentation with septal cartilage is reported with code 30420 alone, whereas a septorhinoplasty requiring dorsal augmentation with rib cartilage is reported as:

30420	Septorhinoplasty
21230-51	Rib cartilage

When a septoplasty or submucous resection is performed alone (not in conjunction with tip or bony dorsum surgery), code 30520 should be used. This code is global and includes all components of septal surgery (resection, scoring, and suturing). If septal surgery is performed at the same time as a primary rhinoplasty, however, use the global septorhinoplasty code: 30420. Because code 30420 includes septoplasty, 30520 is not reported in addition to 30420.

SECONDARY PROCEDURES

Secondary rhinoplasty codes are also global. A "minor" revision (nasal tip) is coded 30430 and includes surgery on the tip cartilages.[1,3] An "intermediate" revision (bony work with osteotomies) is coded 30435 and includes surgery on the bony dorsum, but not the tip. When a "major" revision (tip and osteotomies) is performed, use code 30450. This includes tip cartilage and bony dorsal surgery.

None of the secondary rhinoplasty codes (30430, 30435, or 30450) includes septal surgery. If septal surgery is performed during these secondary procedures, it is coded separately (30520-51). For example, a secondary rhinoplasty involving surgery on the bony dorsum as well as a septoplasty is coded:

30435	Secondary rhinoplasty, bone only
30520-51	Septoplasty

Note that this is a different convention from that for primary rhinoplasty, where the primary septorhinoplasty code, 30420, includes septal surgery. No single global code describes secondary septorhinoplasty: two codes are required to report the procedure. This inconsistency in the CPT book need not be a source of confusion if the surgeon understands what is included in each global code.

No single global code describes secondary septorhinoplasty: two codes are required to report the procedure.

None of the secondary rhinoplasty codes includes harvest of cartilage or bone grafts. These procedures are reported in addition to the secondary rhinoplasty codes. Consider a secondary septorhinoplasty, including tip and bone work, which requires a conchal cartilage graft for tip reconstruction. These procedures are coded:

30450	Secondary rhinoplasty, tip and bone
21235-51	Conchal cartilage graft
30520-51	Septoplasty

This is not unbundling, since each procedure is itemized using CPT guidelines. The code 30450 does not include obtaining the cartilage graft or septal surgery, so these two procedures are reported separately.

CLEFT LIP RHINOPLASTY

Two new codes were created in 1993 to address the intricacies of cleft lip rhinoplasty procedures. Rhinoplasty procedures on patients with cleft lip nasal deformities are not reported with codes 30400-30450.[1,3,4]

A tip rhinoplasty for a cleft lip nasal deformity is reported as 30460. This code is similar to the primary tip rhinoplasty code 30400 in that it does not include osteotomies or septal surgery. Code 30460 includes all components of a tip procedure, including cartilage excision, cartilage suturing, cartilage rotation and repositioning, grafting, and scoring techniques. It is global and comprises surgery on both alar cartilages; using separate codes for each alar cartilage is unbundling.

The code 30462 describes rhinoplasty for cleft lip nasal deformity that includes surgery on the tip as well as the nasal bones and the septum. Thus 30462 is global and includes everything described by code 30460, plus surgery on the septum and nasal bones, including osteotomies.

Both 30460 and 30462 include columellar lengthening, regardless of technique. Soft tissue advancement techniques to lengthen the columella, including flaps, are not separately reported, because they are included in each of these global codes: 30460 and 30462. To code separately for a flap (14060) used for columellar lengthening is unbundling.

If cartilage or bone grafts are used, their placement is included in the global codes 30460 and 30462. Harvest of these grafts is reported separately, however, unless a septal cartilage graft is harvested during the septal surgery described in code 30462. Because septal surgery is performed, the harvest of a septal graft within the same operative field is included in the global code 30462.

VESTIBULAR STENOSIS

In 2001 a code was introduced to describe procedures for vestibular stenosis and vestibular collapse.[1,3] Code 30465 is global and describes the soft tissue and cartilaginous surgery necessary to correct vestibular stenosis, including spreader grafts, composite grafts, and lateral nasal wall reconstruction. The harvest of grafts, however, is separately reported. Code 30465 is an unusual CPT code, because it describes a *bilateral* procedure; to report a unilateral vestibular reconstruction, append the “reduced services” modifier -52: 30465-52.

If we consider a patient with bilateral alar collapse and narrowing of the nasal valves, bilateral septal spreader grafts are placed, as well as bilateral conchal cartilage grafts for alar support. This procedure is reported as:

30465	Repair nasal vestibular stenosis, bilateral
21235-51	Conchal cartilage grafts
20912-51	Septal cartilage spreader grafts

If a septoplasty is performed in addition to the above procedures, it is separately reported (30520). The harvest of septal cartilage for spreader grafts, however, is not reported separately, as the grafts are harvested from within the same operative field (septoplasty). Thus:

30465	Repair nasal vestibular stenosis, bilateral
21235-51	Conchal cartilage grafts
30520-51	Septoplasty

TISSUE GRAFTING

All rhinoplasty codes (primary, secondary, and cleft lip rhinoplasty) include the *placement* of bone and cartilage grafts. *Harvesting* the grafts, however, is separately reported, and the appropriate graft harvest codes (20912, 21210, 21230, 21235, and 15760) are used in addition to the rhinoplasty codes.

All rhinoplasty codes (primary, secondary, and cleft lip rhinoplasty) include the placement of bone and cartilage grafts.

Two important exceptions should be noted. If the septum is operated on for any reason (30420, septorhinoplasty; 30462, cleft lip septorhinoplasty; 30520, septoplasty), then the harvest of grafts from the septum to be placed elsewhere is not separately reportable, since the grafts are harvested from within the same operative field. Code 20912 is not used to report septal graft harvest in such situations.

If the tissue graft is the *only* surgical procedure performed to correct the nasal deformity, then only the tissue graft procedure is reported and the rhinoplasty code is not used. The tissue graft codes include *harvest* and *placement* of these grafts in these situations. A rib cartilage onlay graft for dorsal augmentation *where no other nasal surgery is performed* would be reported with code 21230 alone.

COSMETIC VERSUS RECONSTRUCTIVE PROCEDURES

Rhinoplasty CPT codes do not distinguish between cosmetic and reconstructive procedures.[5,8] Code 30410, for example, describes cosmetic reduction of a dorsal hump with osteotomies. This code also describes a dorsal straightening after trauma that requires osteotomies. It is ICD-9 codes that indicate the reasons procedures are performed. For a purely cosmetic procedure use code V50.1. For a posttraumatic procedure use ICD-9 codes 738.0 (acquired nasal deformity), 733.81 (malunion of nasal fracture), or 905.0 (late effect of nasal fracture). Cosmetic procedures are not submitted for insurance reimbursement, whereas reconstructive procedures are often insurance reimbursable.

Rhinoplasty CPT codes do not distinguish between cosmetic and reconstructive procedures.

For a procedure that is part cosmetic and part reconstructive, however, which procedure is done and for what reason should be itemized—this is not unbundling. The reasons for each procedure are indicated with appropriate ICD-9 codes. For example, a septoplasty is performed for breathing obstruction resulting from a posttraumatic nasal septal deviation. The patient requests that the surgeon narrow her nasal tip "while you are there." Because a portion of this procedure is cosmetic, the procedures are coded as follows:

30520	Septoplasty	ICD-9 codes: 470, 478.1, 905.0
30400-51	Tip rhinoplasty	ICD-9 code: V50.1

The septoplasty should be preauthorized *in writing* with the insurance company preoperatively. Only one operative report is dictated, describing both procedures. The operative report must clearly distinguish which parts of the procedure are

cosmetic and which are reconstructive, including operating times for each portion. The cosmetic portion of the procedure should not be submitted for third-party reimbursement.

OTHER CODES

The nasal fracture codes (21325-21355) are not used for septorhinoplasty procedures, although one may be treating the sequelae of trauma. The nasal fracture codes are used to describe reductions of acute fractures. When osteotomies or septal surgeries are performed on *healed fractures,* septorhinoplasty codes are used.

The nasal fracture codes are not used for septorhinoplasty procedures, although one may be treating the sequelae of trauma.

CPT 30620 should not be used for septorhinoplasty procedures. This code describes "septal or other intranasal dermoplasty," a procedure for telangiectatic nasal bleeding, in which the septal mucosa is removed and replaced with a skin graft. Unfortunately, the text for this code used to read "reconstruction, functional, internal nose" and has caused some confusion because of the use of the term "reconstruction." Procedures performed for septal deviation should be coded 30420 or 30520.

CODING EXAMPLE

A patient on whom a cosmetic rhinoplasty was performed several years ago is involved in an accident and fractures his nose. He is seen several weeks later, after he develops breathing difficulty. Examination reveals that the nasal dorsum is collapsed and deviated to the left. The septum is deviated into the left nasal cavity, and air entry is diminished on the left side. A septorhinoplasty, including a dorsal rib cartilage graft, is performed to correct the deformity and relieve breathing difficulty. No tip work is necessary.

Diagnoses

738.0	Acquired nasal deformity (1)
905.0	Late effect of fracture of nasal bones (2)
470	Deviated nasal septum (3)
478.1	Airway obstruction (4)

Procedures

30435	Rhinoplasty, secondary; (osteotomies) (1, 2)
30520-51	Septoplasty (3, 4)
21230-51	Rib cartilage graft (1, 2)

A previous rhinoplasty had been performed, so the secondary rhinoplasty code, 30425, is used. Because none of the secondary rhinoplasty codes includes septal surgery, the septoplasty is coded separately. The harvest of the rib cartilage graft is also reported separately.

CONCLUSION

Coding rhinoplasty procedures is generally straightforward. Reporting more complex procedures, however, including those requiring grafting, requires a detailed knowledge of CPT codes available and what each code includes in its global description.

RHINOPLASTY CODING PEARLS

- *Placement of tissue grafts* is included in all rhinoplasty codes.
- *Harvest of tissue grafts* is separately reported, unless the graft is harvested from within the operative field.
- Specifically, rhinoplasty codes 30400, 30410, 30430, 30435, 30450, 30460, 30465 include placement of tissue grafts as part of the procedures. Harvesting of the grafts is reported with codes 20912, 21230, 21235, and 21210 in addition to the primary rhinoplasty code.
- Rhinoplasty codes 30420 (septorhinoplasty), 30462 (cleft lip rhinoplasty, including septum), and 30520 (septoplasty) involve surgery on the septum. If a septal cartilage graft is harvested and used elsewhere in the nose, the harvest of the graft is included, so 20912 is not separately reported.
- If a nonseptal graft is used for procedures reported with codes 30420 (septorhinoplasty), 30462 (cleft lip rhinoplasty, including septum), and 30520 (septoplasty), the graft harvest is reported separately (21210, 21230, 21235).
- Secondary rhinoplasty procedures do not include septal surgery, which is reported separately (30520).
- All nasal procedures which will be submitted for insurance reimbursement must be preauthorized *in writing* by the payer before surgery.
- When a combined reconstructive and cosmetic rhinoplasty is performed, only one operative report is dictated.

Commonly Used ICD-9 Codes for Nasal Surgery

470	Deviated nasal septum
478.1	Nasal airway obstruction
733.81	Malunion nasal/septal fracture
738.0	Acquired nasal deformity
754.0	Congenital nasal/septal deformity
905.0	Late effect of fracture of skull or facial bones
V50.1	Plastic surgery for unacceptable cosmetic appearance

KEY POINTS

- No single global code describes secondary septorhinoplasty: two codes are required to report the procedure.
- All rhinoplasty codes (primary, secondary, and cleft lip rhinoplasty) include the placement of bone and cartilage grafts.
- Rhinoplasty CPT codes do not distinguish between cosmetic and reconstructive procedures.
- The nasal fracture codes are not used for septorhinoplasty procedures, although one may be treating the sequelae of trauma.

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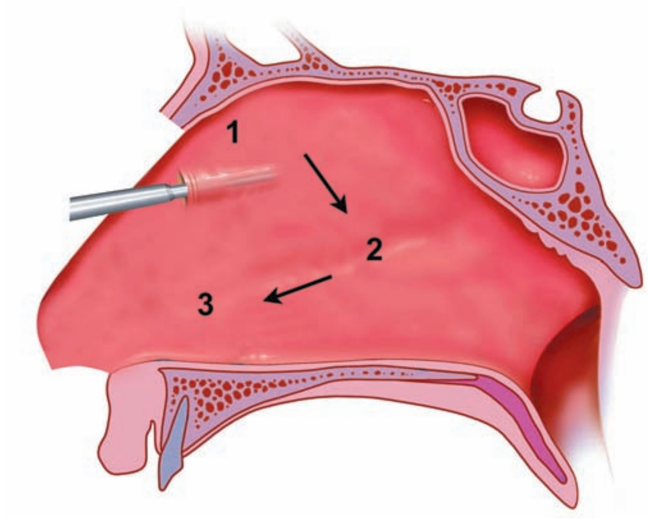
PART TWO

Basic Surgical Concepts



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10

Getting Rhinoplasty Right the First Time

Rod J. Rohrich ▪ Jamil Ahmad

Primary rhinoplasty offers the surgeon a unique opportunity to manipulate undisturbed tissue planes and native anatomy to produce a result that meets both aesthetic and functional goals. Subsequent procedures are technically more difficult and less predictable because of scarring within the nasal soft tissue envelope and the potential for inadequate structural support resulting from prior alteration of the osteocartilaginous nasal framework. Accurate initial assessment and proper execution of primary rhinoplasty based on the anatomic deformity and using a graduated surgical approach is therefore critical.

The basic principles for successful primary rhinoplasty include the following:

1. Thorough clinical analysis and definition of goals preoperatively
2. Careful preoperative preparation of the patient
3. Precise operative execution
4. Adequate postoperative management
5. Expertise and experience gleaned from critical analysis of one's own results

This chapter will focus on lessons learned from a 25-year experience with primary rhinoplasty. Current key concepts and strategies for success are presented. Preoperative preparation, clinical analysis, and postoperative management are covered in detail in Chapters 5, 6, and 8, respectively.

Key Concepts and Strategies for Success

Over the past 25 years, the following key concepts and strategies for success have emerged. These play a critical role in getting rhinoplasty right the first time:

1. Use the open approach.
2. Incrementally reduce the dorsum.
3. Use invisible grafts.
4. The best chance to get the result is during the primary rhinoplasty.
5. Follow patients long term.

USE THE OPEN APPROACH

Although the closed approach does provide access to the nasal structures for rhinoplasty, it is our opinion that the open approach provides far greater exposure and opportunity to more accurately assess and manipulate the structural elements of the nose.[1,2] The closed approach is therefore reserved for correction of isolated deformities and straightforward manipulations of the nasal tip. Patients requiring extensive tip work, component dorsal hump reduction, and any case requiring precise control are completed through the open approach.

Rationale for the Open Rhinoplasty Approach

Distinct Advantages
Binocular visualization
Evaluation of complete deformity without distortion
Precise diagnosis and correction of deformities
Allows use of both hands
More options with original tissues and cartilage grafts
Direct control of bleeding with electrocautery
Suture stabilization of grafts (invisible and visible)

Potential Disadvantages
Transcolumellar scar
Prolonged operative time
Protracted nasal tip edema
Columellar incision separation
Delayed wound healing

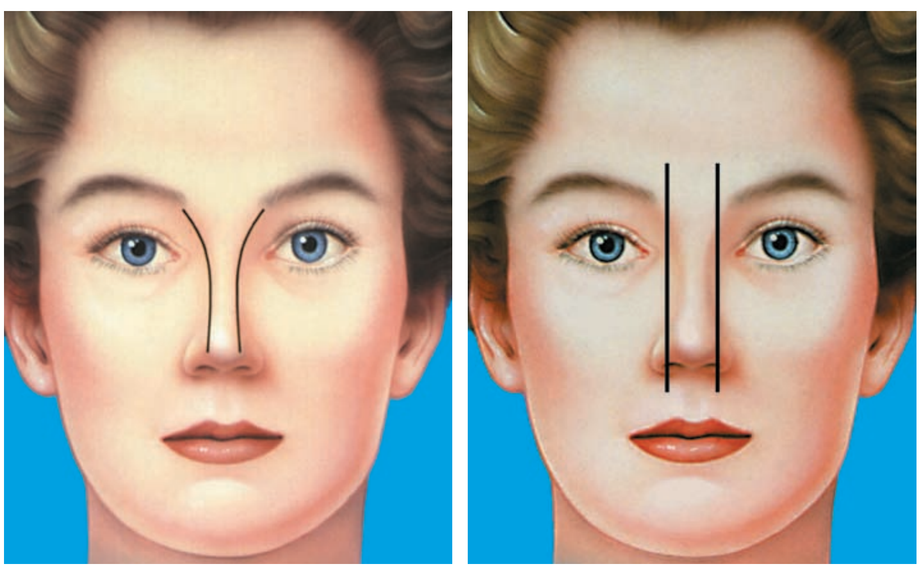
Characteristics of the open approach that have led to our preference include the following:

1. It provides clear anatomic exposure of the nasal deformity, allowing a more accurate diagnosis of the cause of the external deformity.
2. It facilitates the performance of technical maneuvers allowing preservation and/or restoration of specific structures using incremental control.
3. It provides the surgeon with more options in altering the osteocartilaginous framework and improved accuracy in suture and graft placement, which is crucial to a well-executed operation.

The open rhinoplasty technique provides unparalleled exposure for accurate anatomic diagnosis and systematic technical execution.

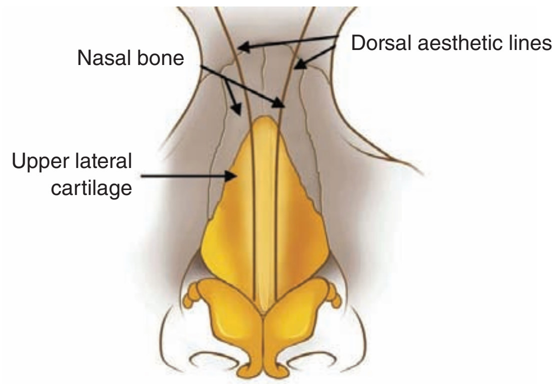
INCREMENTALLY REDUCE THE DORSUM

One of the most common reasons that patients seek rhinoplasty is the presence of a dorsal hump. In the past, significant emphasis was placed on achieving an aesthetically pleasing lateral profile, yet little attention was given to the consequences of dorsal hump reduction on the frontal view. As a result, deformities such as the inverted-V deformity were commonplace. Other problems that become evident on the frontal view include issues with the dorsal aesthetic lines, such as poor definition, asymmetries, too narrow, or too wide, and residual deformities of the bony vault.

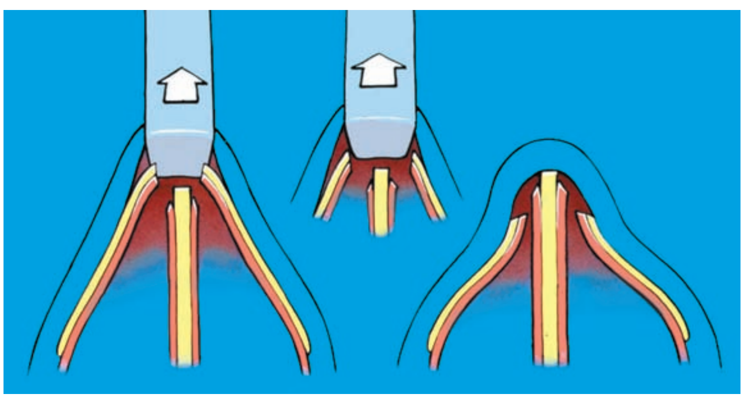


The nasal dorsum should have two symmetrical, smooth dorsal aesthetic lines. They should be slightly curved divergent lines extending from the medial su-

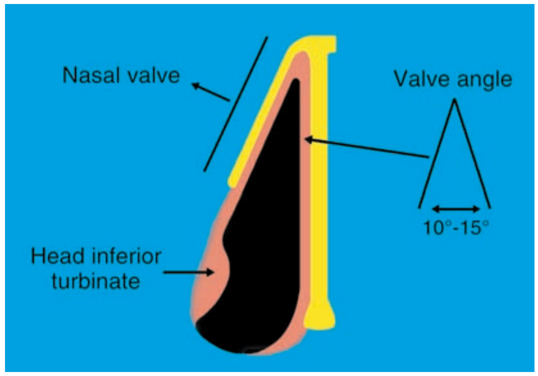
perciliary ridges to the tip-defining points. The width of the bony vault should be about 75% to 80% of the normal alar base width. The base of the bony vault serves as the nose-cheek junction.



A closer look at the dorsal aesthetic lines reveals the complexity of the underlying anatomy. Superiorly, the dorsal aesthetic lines are formed by the soft tissue contours and the underlying nasal bones while inferiorly, the dorsal septum and upper lateral cartilages underlie the soft tissue of the midvault. The dorsal aesthetic lines span the keystone area—the junction of the upper lateral cartilages with the overlying nasal bones.

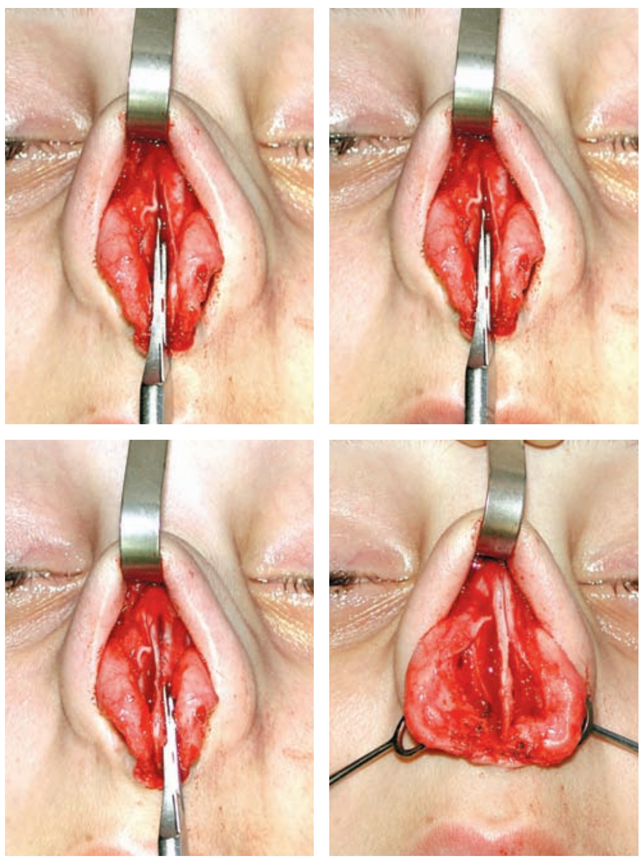


In the past, the approach to the dorsum—using a composite dorsal hump reduction technique—was likely the source of many postoperative problems at the midvault.[3]

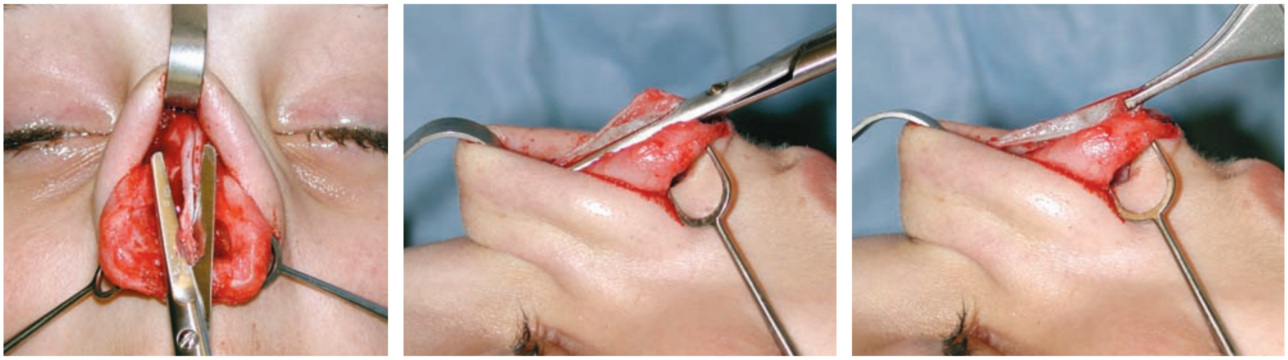


Excess cartilage removal at the midvault leads to poorly defined dorsal aesthetic lines and can also cause problems with the internal nasal valves.

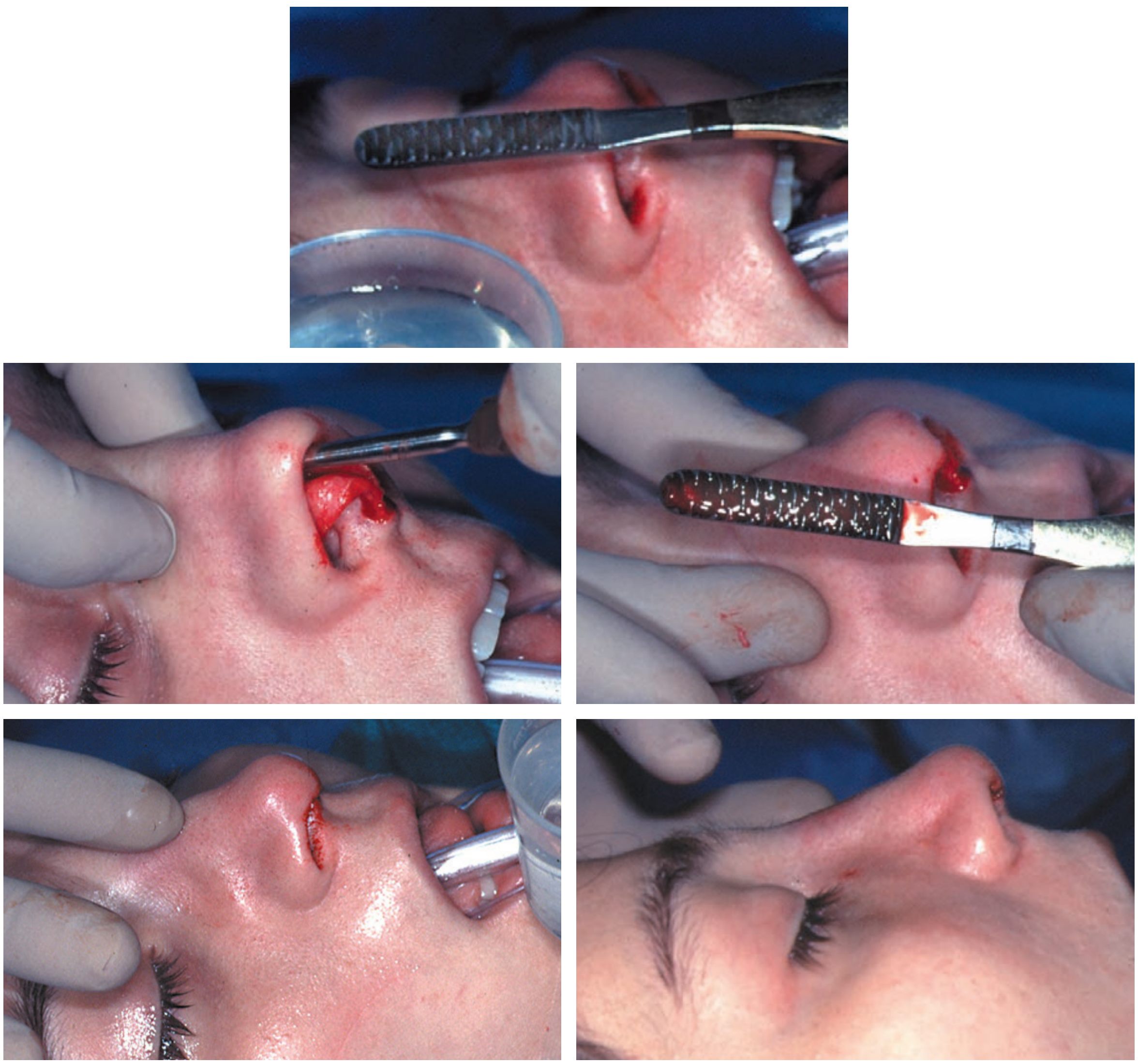
We have evolved a component approach to the dorsum to prevent these undesirable problems.[4,5] It involves the following:



1. Release of the upper lateral cartilages from the dorsal septum



2. Resection of the dorsal septum incrementally

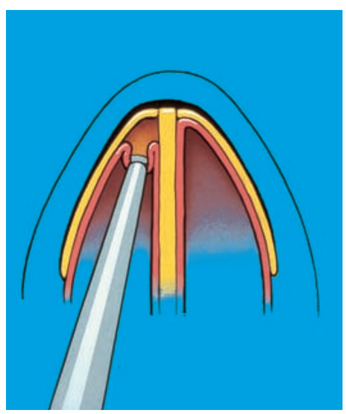


3. Rasping of the bony dorsum

4. Restoration of the dorsal aesthetic lines

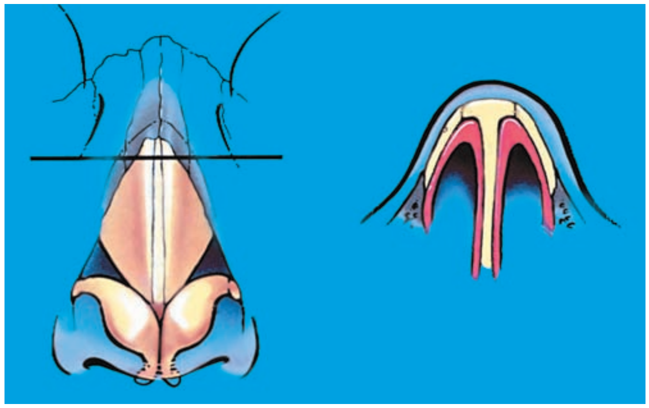
We have evolved a component approach to the dorsum that uses incremental manipulation to establish well-defined and smooth dorsal aesthetic lines while preventing undesirable dorsal deformities or internal valve collapse.

Release of the Upper Lateral Cartilages from the Dorsal Septum

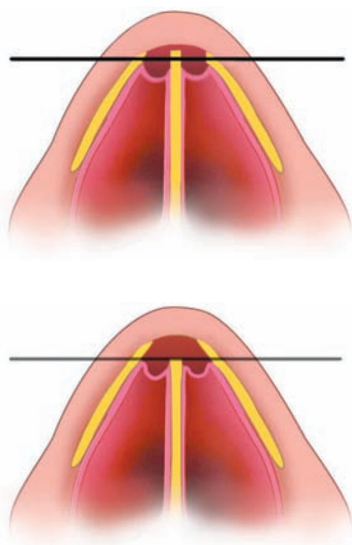


Component dorsal hump reduction separates the dorsal hump into cartilaginous and bony components as well as separating the upper lateral cartilages from the septum and preserving the mucosa of the internal nasal valves.

Resection of the Dorsal Septum Incrementally



The dorsal septum has a T-shaped orientation in cross-section.

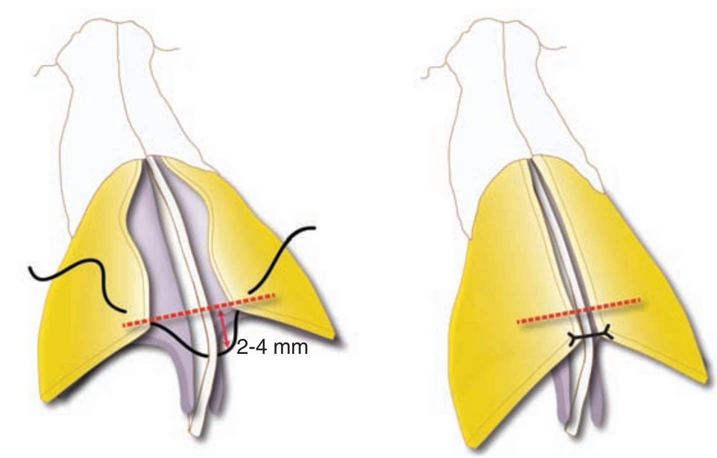


Component dorsal hump reduction allows preservation of this cartilage attached to the dorsal edges of the upper lateral cartilages while the dorsal septum is reduced. This cartilage along with the upper lateral cartilages can be resected independently from the dorsal septum, or the upper lateral cartilages can be used as autospreader flaps.[5-7]

Rasping of the Bony Dorsum

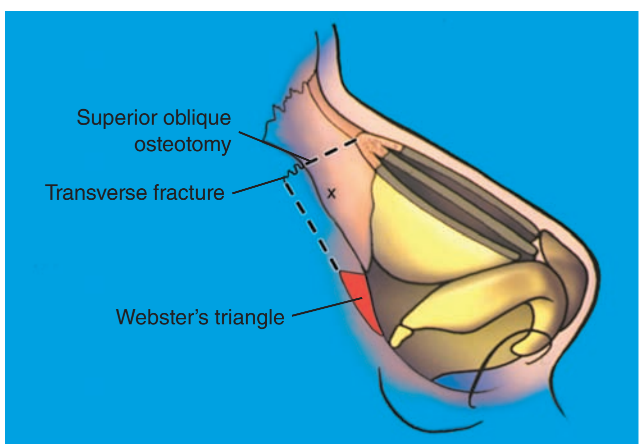
Once the cartilaginous hump has been reduced, the bony hump is incrementally reduced using a rasp. Oblique strokes are used along the dorsal edges of the nasal bones. The dorsum should be constantly reevaluated to ensure a balanced reduction and smooth transition between the bony and cartilaginous humps.

Restoration of the Dorsal Aesthetic Lines



Preservation of the upper lateral cartilages allows for reconstitution of the midvault and restoration of the dorsal aesthetic lines and internal nasal valve. Upper lateral cartilage tension spanning sutures are used to reconstitute the midvault.[8] Preservation of the cartilage has decreased the requirement for spreader grafts to reconstruct the midvault and internal valve. In primary rhinoplasty, indiscriminate use of spreader grafts will lead to excessive midvault width, visibility/palpability, and depletion of cartilage required for grafting elsewhere.

Osteotomies



Frequently after reduction of a dorsal hump, an open roof deformity is created with the superior dorsal aesthetic lines appearing excessively wide. Additionally, the bony vault may be wide or the nasal bones may be deviated. Lateral nasal osteotomies should be used judiciously to correct these deformities.[9-11]

Percutaneous perforated lateral osteotomies are our preferred technique, because they have proved predictable and reliable for correction of the deformities discussed.[9-11] This procedure involves discontinuous perforations made by a sharp 2 mm osteotome along the lateral aspect of the bony pyramid, followed by greenstick infracturing performed with digital manipulation. The skin overlying the maxilla at the nose-cheek junction is perforated at the level of the infraorbital rim down to the subperiosteal plane, followed by a posterior sweep along the bone to push the angular artery away from the osteotomy line. Lateral nasal osteotomies will close the open roof and smooth out the superior dorsal aesthetic lines as well as the osteocartilaginous transition at the keystone area, and can adjust the width of the base of the bony vault.

Therefore the goal of dorsal hump reduction should be twofold: (1) to achieve an aesthetically pleasing lateral profile, and (2) to create smooth, symmetrical, well-balanced dorsal aesthetic lines on frontal view.

USE INVISIBLE GRAFTS

Whether for tip shaping or dorsal contouring, visible grafts are commonly used in rhinoplasty. For many years, the use of visible grafts has been part of the routine as a result of inadequate preoperative analysis and a lack of familiarity or confidence with alternative techniques. However, there is no clear understanding of the long-term consequences of grafts, including displacement, absorption, and changes to the overlying skin envelope.

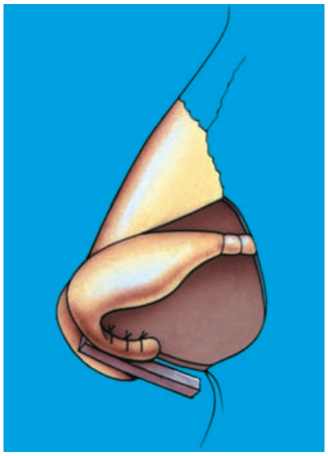
Although grafts are frequently required during rhinoplasty, the surgeon should make an effort to use invisible grafts. These grafts provide additional structural support and improve contour. Furthermore, invisible grafts decrease the long-term consequences associated with visible grafts because of changes in the graft itself or the overlying soft tissues.

We frequently use the following grafts during primary rhinoplasty:

1. Columellar strut graft
2. Alar contour graft
3. Anatomic cap graft
4. Morselized onlay graft
5. Spreader graft

Although grafts are frequently required during rhinoplasty, the surgeon should make an effort to use invisible grafts.

Columellar Strut Graft



Columellar strut grafts are used frequently with the open approach. Columellar strut grafts have long been employed as a means to increase nasal tip projection.[12-14]

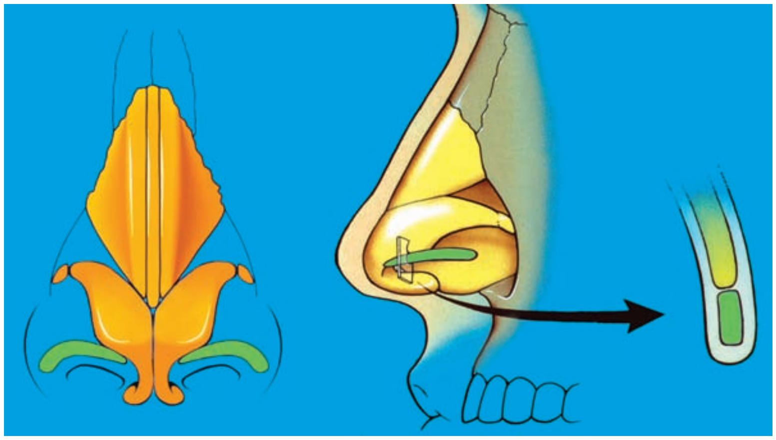
In our recent study 100 consecutive patients who underwent primary rhinoplasty with the use of a columellar strut were analyzed.[12,13] Based on computer analysis of preoperative and postoperative photographs, 65% of these patients actually lost tip projection despite the use of a floating columellar strut. As opposed to increasing tip projection, columellar strut grafts appear to have more effect on maintaining tip projection and unifying the tip complex. Additionally, the columellar strut graft can add support when the medial crura are weak.

There are several specific nasal morphologies that benefit from the additional support gained by placing a columellar strut graft:

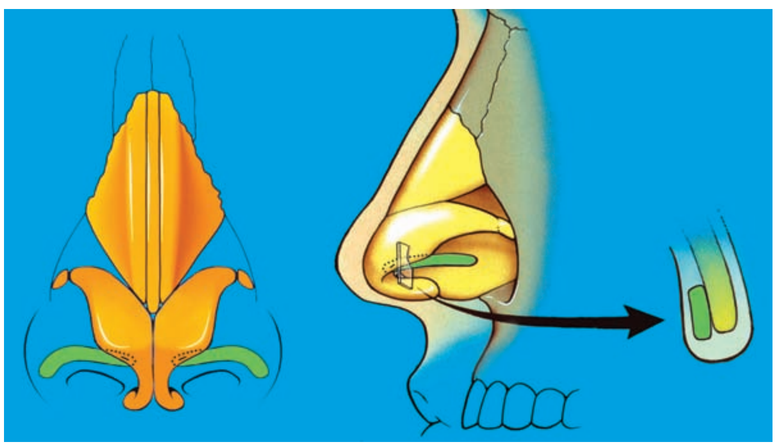
1. The hanging tip
2. The dynamic tip
3. The tension tip
4. Alar-columellar discrepancies with columellar retraction
5. Irregularities of the medial crura
6. The aging nose

Alar Contour Graft

The lower lateral cartilage is the structural cornerstone for the alar rim and overall tip support.[15] However, it is the strength, anatomic positioning, and orientation of the lateral crus that are paramount to the location, contour, and stability of the ala. External valve collapse, notching, and retraction can all become apparent when the lateral crus is unable to provide proper support for nasal soft tissues that become further stressed with inspiratory effort. In patients with alar rim collapse or weakness, the soft triangle appears notched from lack of underlying cartilaginous support.

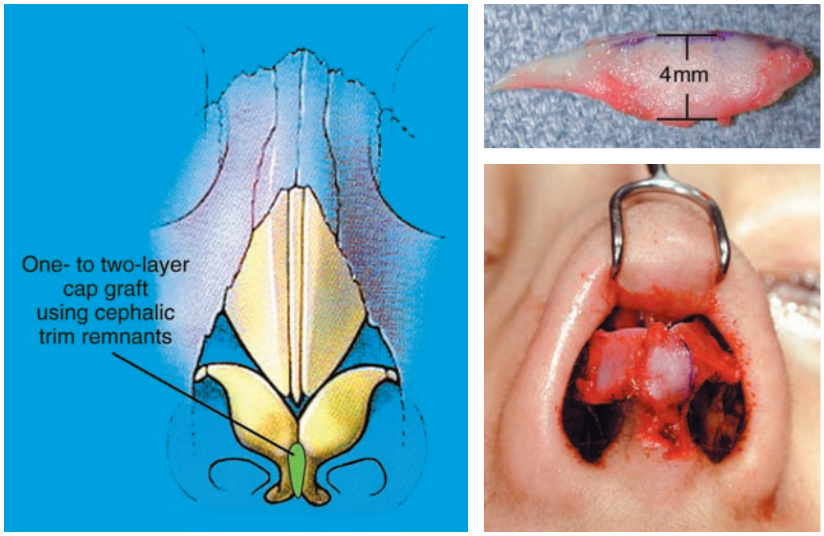


For the past two decades we have used alar contour grafts as a simple yet effective rhinoplasty technique for improved contouring of the alar rim; this involves nonanatomic insertion of an autologous cartilage graft into a pocket along the alar rim.[16] The alar contour graft provides a foundation for reestablishment of a normally functioning external nasal valve and an aesthetically pleasing nasal tip and alar contours. The use of alar contour grafts decreases the risk of alar deformities including alar notching or retraction, as well as excessive concavity or convexity of the alar rim.



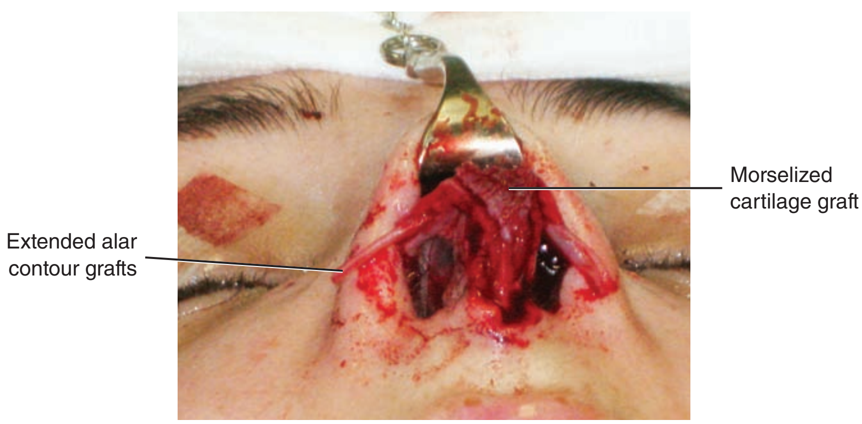
More recently, the extended alar contour graft has been used to prevent notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture. Additionally, the extended alar contour graft can influence the rotational orientation of the lateral crus so that the caudal and cephalic borders are rotated into the same horizontal plane, further influencing the tip and alar contours.[17]

Anatomic Cap Graft



Visible tip grafts used to be a mainstay of tip shaping during rhinoplasty. However, with the widespread use of tip-suturing techniques and their versatility, we use visible tip grafts much less often. Instead, if a small degree of tip contouring or volume augmentation is desired after tip suturing is completed, an anatomic cap graft can be used.[18,19] Cartilage resulting from the cephalic trim of the lower lateral cartilage can be used to fashion an anatomic cap graft. This cartilage graft is typically thin and pliable, so it contours over the tip very well, and it does not have any distinct edges, so palpability and/or visibility of the graft is not a problem.

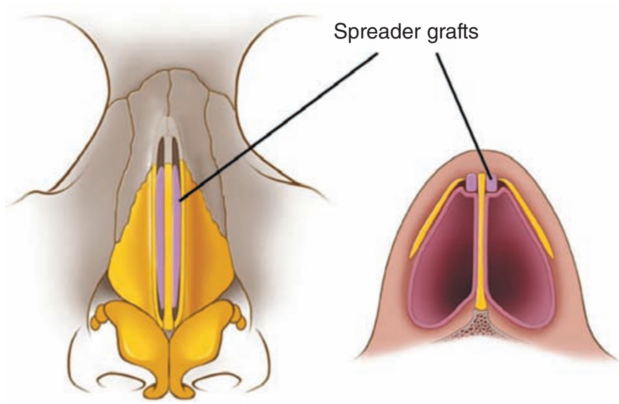
Morselized Cartilage Onlay Graft



In areas that require minimal augmentation or improvement of mild irregularities of the osteocartilaginous framework, morselized cartilage onlay grafts can

be placed. The cartilage is morselized in a cartilage crusher and can range from being slightly bruised (to make it less rigid and more conforming without sharp edges) to crushed into a thin sheet (that can act as a scaffolding for tissue ingrowth). Morselized cartilage onlay grafts can be used anywhere for augmentation or correction of mild irregularities. We have most commonly used it as a tip graft or along the dorsum for dorsal irregularities.

Spreader Graft



Spreader grafts are used to reconstitute the dorsal aesthetic lines, correct dorsal deviation, enhance nasal length, and reconstruct the internal nasal valves. Preservation of the cartilage has decreased the requirement for spreader grafts to reconstruct the midvault and internal valve. In primary rhinoplasty, indiscriminate use of spreader grafts will lead to excessive midvault width, visibility/palpability, and depletion of cartilage required for grafting elsewhere. Spreader grafts should only be used when necessary. We most commonly use unilateral or bilateral placement of spreader grafts for correction of dorsal deviation or reconstruction of the internal valves.

THE BEST CHANCE TO GET THE RESULT IS DURING PRIMARY RHINOPLASTY

Primary rhinoplasty offers the surgeon a unique opportunity to manipulate undisturbed tissue planes and native anatomy to produce a result that meets both aesthetic and functional goals. It is during this first nasal surgery that the opportunity to achieve the best result exists. Subsequent procedures are technically more difficult and less predictable for a multitude of reasons. Scarring within the nasal soft tissue envelope can create irregularities, fibrotic and inelastic skin, and thinner or thicker skin in certain areas. Alterations in the underlying osteocartilaginous framework during previous surgery leads to the potential for inadequate structural support. Cartilage is often required during secondary rhinoplasty; however, adequate cartilage for grafting may no longer be available in the

nose, necessitating harvest from remote sites, including the ear and ribs. Finally, and what is most important, the patient's emotional state is often quite different when presenting for primary versus secondary rhinoplasty. In many instances, the patient requiring a secondary procedure is upset over his or her previous surgery, and this may result in challenges establishing trust, which is critical to the doctor-patient relationship.

Primary rhinoplasty offers the surgeon a unique opportunity to manipulate undisturbed tissue planes and native anatomy to produce a result that meets both aesthetic and functional goals. It is during this first nasal surgery that the opportunity to achieve the best result exists.

FOLLOW PATIENTS LONG TERM

Expertise and experience are gleaned from critical analysis of one's own results. We learn through analyzing factors that play a role in a successful rhinoplasty. We learn even more from shortcomings or failure to achieve the desired goals of surgery.

Looking back critically at a 25-year experience with primary rhinoplasty, the goals of surgery were more frequently met as more experience was gained:

First 5 years	Could revise 85%
Next 10 years	Could revise 15%
Last 10 years	Could revise 5%
Actual revision rate	3.5%

The results of certain techniques were maintained over the long term, whereas others did not hold up well over time. By critically examining our long-term results, we have found that the early results using visible grafts had the potential to develop late deformities from changes in the graft themselves or their displacement. Additionally, techniques that preserve cartilage when possible and/or provide additional structural support, such as columellar strut grafts and alar contour grafts, improve longevity of the result after rhinoplasty. Our approach has evolved to apply the information gathered from these observations to provide increased consistency and longer durability in results after primary rhinoplasty.

Expertise and experience are gleaned from critical analysis of one's own results. We learn through analyzing factors that play a role in a successful rhinoplasty; what is more important, we learn even more so from shortcomings or failures to achieve the desired goals of surgery.

CONCLUSION

The best chance to get the result is during the primary rhinoplasty. Accurate initial assessment and proper execution of primary rhinoplasty based on the anatomic deformity and using a graduated surgical approach is critical.

Over the past 25 years, several key concepts and strategies for success have emerged and play a critical role in getting rhinoplasty right the first time. The open approach provides great exposure and opportunity to more accurately assess and manipulate the structural elements of the nose. When manipulating the dorsum, a component dorsal approach is used. This allows a graduated approach with preservation and proper reconstitution of upper lateral cartilages when reducing a dorsal hump to ensure an aesthetically pleasing lateral profile and smooth and symmetrical dorsal aesthetic lines on the frontal view. Although grafts are frequently required during rhinoplasty, the surgeon should make an effort to use invisible grafts. These grafts provide additional structural support as well as improve contour; however, invisible grafts decrease the long-term consequences associated with visible grafts due to changes in the graft itself or the overlying soft tissues. Finally, it is critical to follow patients long term. Expertise and experience are gleaned from critical analysis of one's own results.

KEY POINTS

- The open rhinoplasty technique provides unparalleled exposure for accurate anatomic diagnosis and systematic technical execution.
- We have evolved a component approach to the dorsum that uses incremental manipulation to establish well defined and smooth dorsal aesthetic lines while preventing undesirable dorsal deformities or internal valve collapse.
- Although grafts are frequently required during rhinoplasty, the surgeon should make an effort to use invisible grafts.
- Primary rhinoplasty offers the surgeon a unique opportunity to manipulate undisturbed tissue planes and native anatomy to produce a result that meets both aesthetic and functional goals. It is during this first nasal surgery that the opportunity to achieve the best result exists.
- Expertise and experience are gleaned from critical analysis of one's own results. We learn through analyzing factors that play a role in a successful rhinoplasty; what is more important, we learn even more so from shortcomings or failures to achieve the desired goals of surgery.

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11

Frequently Used Grafts in Rhinoplasty: Nomenclature and Analysis

Jack P. Gunter ▪ Alan Landecker ▪ C. Spencer Cochran

Over the past few decades, numerous grafting techniques have been developed to sculpt the nasal framework in primary and secondary rhinoplasty. These techniques have originated from the basic principle that maintenance of the major supporting structures of the nose is fundamental for aesthetic and functional purposes. Failure to maintain or furnish needed support results in suboptimal results with deformities that are challenging to correct.

Maintenance of the major supporting structures of the nose is fundamental for aesthetic and functional purposes.

Failure to maintain or furnish needed support results in suboptimal results, with deformities that are challenging to correct.

BACKGROUND

Discussion of these grafting techniques at meetings and in the plastic surgery literature has greatly improved our results in modern rhinoplasty. However, surgeons have been confused by the significant variability in the nomenclature, anatomic position, and clinical indications for each graft. In this chapter we will analyze these aspects of the most commonly used grafts in modern rhinoplasty to provide a simple and easy-to-reference rhinoplasty grafting guide for surgeons at all levels.[1] Grafts described in the guide are listed according to their intended location on the nose, and in alphabetical order within each group. With the help of the Gunter Rhinoplasty Diagrams (Canfield Scientific, Inc., Fairfield, NJ), each

graft is didactically presented and analyzed for its nomenclature, anatomic location, and clinical indications. This grafting guide was evaluated by numerous expert surgeons before its completion to include their experience, preferred nomenclature, and technical modifications. They are acknowledged at the end of the chapter.

Overview of Rhinoplasty Grafts by Region

Dorsum	Autospreader flap
	Dorsal onlay graft
	Dorsal sidewall onlay graft (lateral nasal wall graft)
	Radix graft
	Spreader grafts
	Septal extension graft
Tip	Anchor graft
	Cap graft
	Columellar strut graft (fixed)
	Columellar strut graft (floating/fixed floating)
	Extended columellar strut–tip graft (extended shield graft)
	Onlay tip graft
	Shield graft (Sheen or infralobular graft)
	Subdomal graft
	Umbrella graft
Alar region	Alar batten graft
	Alar contour graft (alar rim graft)
	Alar spreader graft (lateral crural spanning graft)
	Composite alar rim graft
	Lateral crural onlay graft
	Lateral crural strut graft
	Lateral crural turnover flap
Base	Alar base graft
	Columellar plumping grafts
	Premaxillary graft

This is a generalized description of the grafts, and sometimes the shape, position, and usage vary depending on the situation and desires of the surgeon. However, we hope that this information will improve the understanding and teaching of this fascinating operation.

The shapes, position, and usage of grafts vary depending on the situation and the desires of the surgeon.

Gunter Diagram System

The Gunter Rhinoplasty Diagrams were introduced in 1989 to graphically document the intraoperative maneuvers in rhinoplasty.[2] They serve as valuable tools for postoperative evaluation of the patient and effective teaching instruments for surgeons learning the technical steps performed in rhinoplasty.

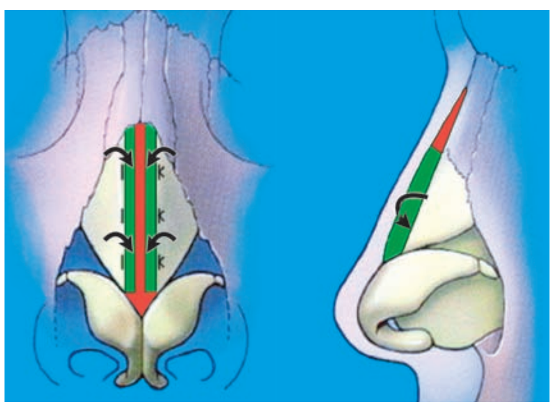
An individualized Gunter diagram is included to depict the anatomic position of each graft described. The color key for interpretation of the diagrams is as follows:

Green	=	Autologous grafts
Black	=	Sutures and outline of anatomic structures
Red	=	Incisions and excisions
Orange	=	Previous incisions or excisions
Blue	=	Implants
Pink	=	Homografts (for example, irradiated cartilage or dermal homograft)

For more information on Gunter diagrams, see “Interpreting the Gunter Rhinoplasty Diagrams” in the front of this book.

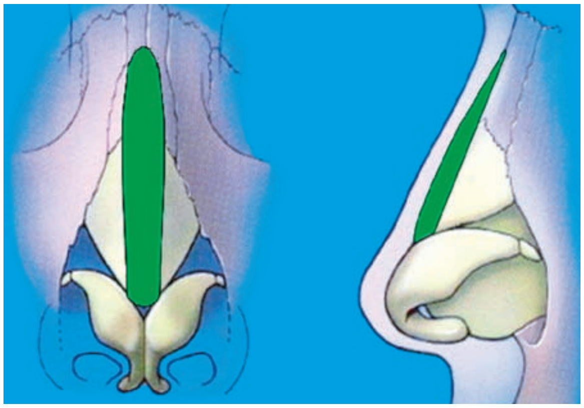
GRAFTS OF THE NASAL DORSUM

Autospreader Flap



An autospreader flap is used to control the width of the midvault while maintaining the integrity of the internal nasal valve.[3-5] After separation of the upper lateral cartilages from the dorsal septum, the excess portion of the upper lateral cartilages is used as an autospreader flap. It is fashioned by rotating the transverse portion of the upper lateral cartilage internally, followed by suture fixation to the dorsal septum. The sutures can be tightened to adjust the width of the midvault.

Dorsal Onlay Graft

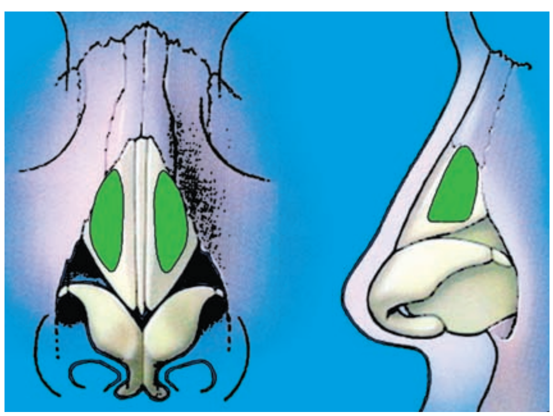


A dorsal onlay graft is a longitudinal graft used to augment the nasal dorsum.[6] The graft best spans the entire length of the dorsum from the radix to the septal angle. However, to prevent visible step-off deformities, it can be used for shorter distances to correct localized depressions, asymmetries, or irregularities.

Septal cartilage is the preferred source for minimal to moderate augmentation with a dorsal onlay graft, but costal cartilage usually is required for large augmentations.

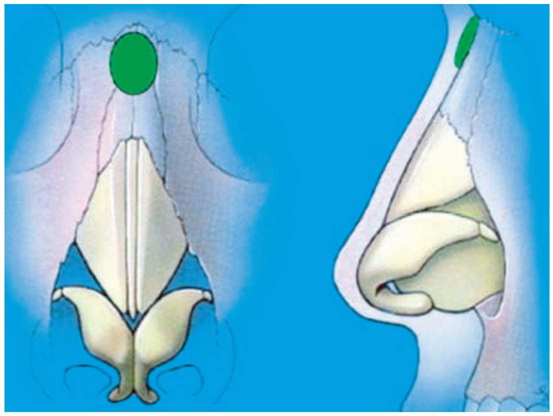
Internal stabilization of costal cartilage grafts is recommended to prevent warping.[7] Auricular cartilage is used occasionally but has the disadvantage of being difficult to shape so that it has a smooth surface. To prevent displacement, dorsal onlay grafts should be fixed to the underlying framework with sutures or a percutaneous K-wire.

Dorsal Sidewall Onlay Graft (Lateral Nasal Wall Graft)



Dorsal sidewall onlay grafts are placed along the lateral side of the nose and have different shapes and sizes depending on the indications.[8] They are used to combat localized lateral depressions or asymmetries of the body of the nose and especially to camouflage collapse of the upper lateral cartilages. The graft may be crushed to help hide sidewall irregularities. If placed over bone, the graft is more likely to be palpable or visible, because the bony base is unyielding.

Radix Graft

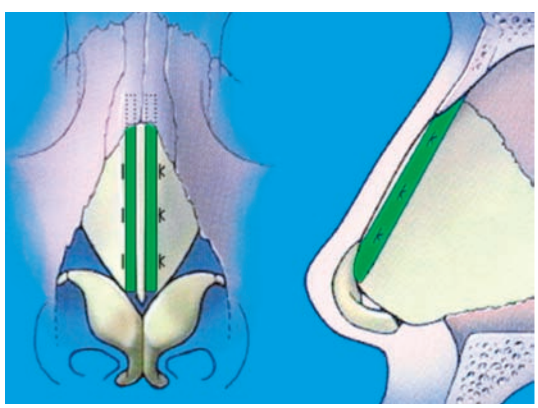


A radix graft is a single or layered dorsal graft placed in a tight pocket that is created over the radix.[9] If the pocket is larger than the graft, the graft is fixed in place with percutaneous sutures or K-wires. Radix grafts are used to augment an inadequate nasofrontal angle or to redefine the radix breakpoint further cephalad, which causes an apparent lengthening of the nose.

The shape and thickness of a radix graft will depend on the amount of augmentation desired.

The edges of a radix graft should be crushed or carefully beveled to prevent visibility.

Spreader Grafts



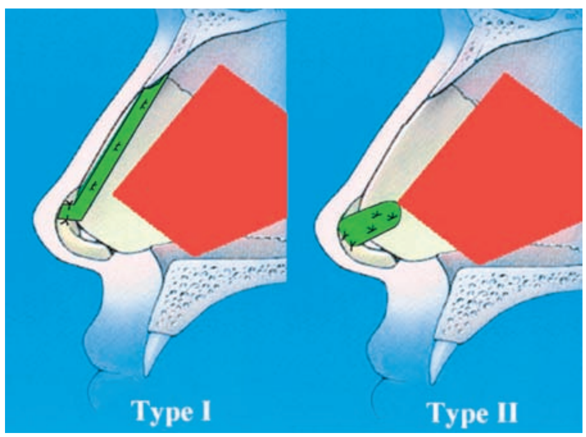
Spreader grafts are usually paired, longitudinal grafts placed between the dorsal septum and the upper lateral cartilages in a submucoperichondrial pocket.

Spreader grafts are used to restore or maintain the internal nasal valve, straighten a deviated dorsal septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity.[10]

Septal cartilage is the preferred source of spreader grafts. The length and shape can vary depending on the indication. The grafts may extend above the level of the dorsal septum to slightly augment the dorsum (pistol grafts) or caudally beyond the septal angle to lengthen the nose or increase tip projection. They are suture-fixated to the septum before reapproximation of the upper lateral cartilages to the septum–spreader graft complex.

Spreader grafts are used to restore or maintain the internal nasal valve, straighten a deviated dorsal septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity.

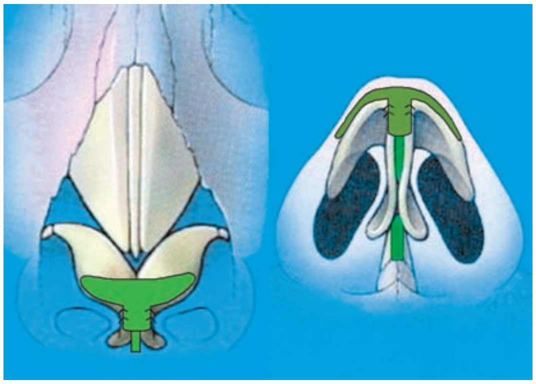
Septal Extension Grafts



Septal extension grafts are used to control the projection, support, shape, and rotation of the tip and are dependent on the presence of a stable caudal septum.[11] They also help to create a supratip break. The grafts are divided into three types. Type I grafts function as paired dorsal spreader grafts that extend beyond the anterior septal angle into the interdomal space. Type II grafts are paired batten grafts that extend diagonally across the caudodorsal junction of the septal L-strut into the tip-lobule complex. Type III grafts function as direct extension grafts affixed to the anterior septal angle. Although septal cartilage is the preferred source, both auricular and rib cartilage have been used.

GRAFTS OF THE NASAL TIP

Anchor Graft

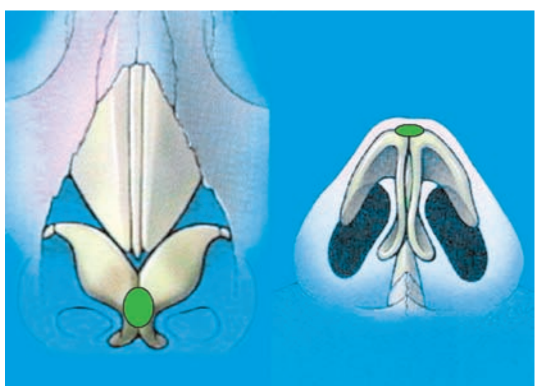


Anchor grafts can be used to improve tip support and/or projection and collapse or deformation of the lateral crura.[12] These are anchor-shaped grafts whose shaft is sutured to the caudal margin of the medial crura. The transverse components (wings) may replace the lateral crura or lie over their remnants and are sutured to them.

Anchor grafts may be used to improve tip support and/or projection and collapse or deformation of the lateral crura.

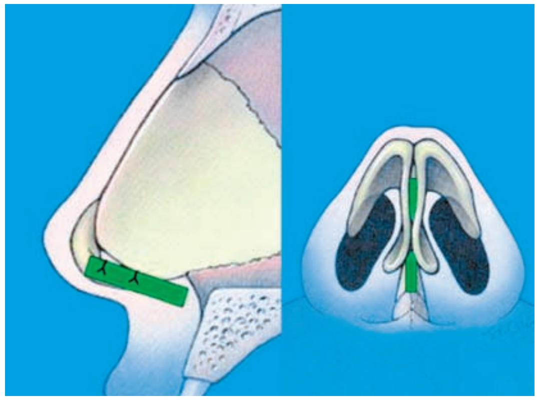
The graft is harvested from the auricular concha and is then designed according to the patient's needs. Symmetrical carving of the wings can be difficult because of the asymmetries of the conchal bowl.

Cap Graft



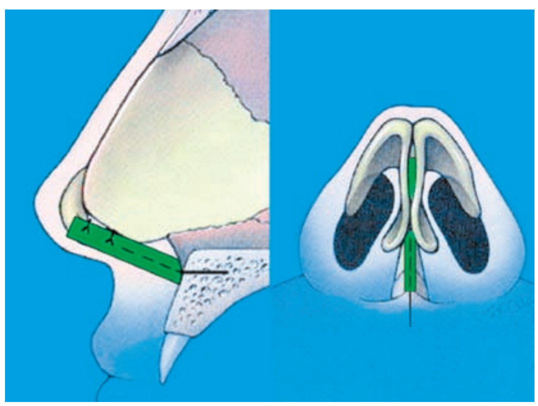
A cap graft is a small graft placed in the space between the tip-defining points and the middle crura. The graft is used to refine, soften, and fill in clefts of the nasal tip in patients who have thin skin to minimally enhance tip projection and occasionally refine the infratip lobule area.[13,14] The preferred source of cartilage is remnants obtained from the cephalic trim of the lower lateral cartilages, but septal or auricular cartilage may also be used.

Columellar Strut Graft (Floating/Fixed Floating)



A floating columellar strut is a graft placed in a tight pocket that is dissected between the medial crura through a small incision caudal to the feet of the medial crura (endonasal approach).[15] A fixed-floating columellar strut (open approach) is sutured to the medial crura for stabilization. A 2 to 3 mm pad of soft tissue is usually maintained between the graft and the nasal spine to prevent movement of the graft back and forth over the spine with lip movements.[16] A columellar strut helps to maintain tip support and increase tip projection and aids in shaping the columellar-lobular angle. Septal cartilage is preferred, but costal cartilage is used when a stronger strut and more enhanced projection are desired. Auricular cartilage may be used, but a double layer is required if strength is needed.

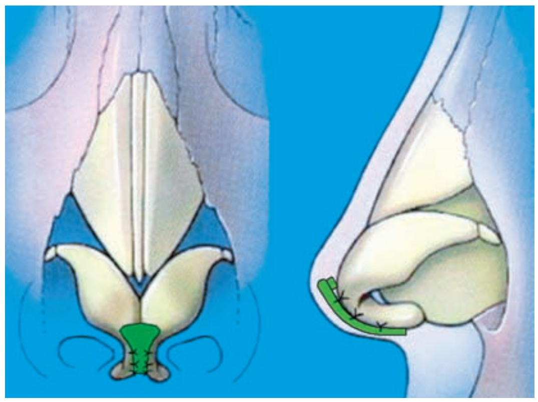
Columellar Strut Graft (Fixed)



Columellar struts may be fixed to the nasal spine or premaxilla to provide more stable support to the nasal tip. A fixed columellar strut is the most effective way to increase tip projection with a strut and can also aid in lengthening the nose.[7] When rib cartilage is used, stabilization and control are enhanced with a 0.035-

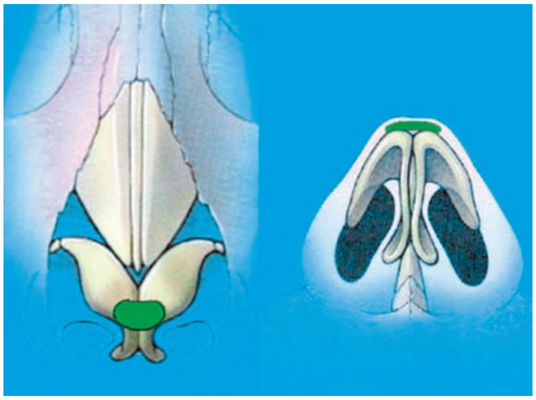
inch threaded K-wire inserted longitudinally in the strut. (A K-wire cannot be placed in septal cartilage because it is too thin.) The K-wire should be inserted up to three-fourths the length of the strut, leaving 10 mm exposed at the base. This is then placed in a 12 mm drill hole just lateral to the maxillary midline, parallel and inferior to the nasal floor. When fixed with a K-wire, the medial crura can be advanced and sutured to the strut to control projection, and rotation can be controlled by the angle made in the K-wire at the base of the strut.

Extended Columellar Strut–Tip Graft (Extended Shield Graft)



An extended columellar strut–tip graft is an elongated shield-shaped graft that lies caudal to or between the medial crura and extends anteriorly to project beyond the domes and posteriorly toward the medial crural footplate.[17] The graft provides tip support, projection, definition, and fullness caudal to the medial crura to aid in shaping the columella. It is stabilized in a tight pocket in the precrural space (endonasal approach), or it is placed caudal to or between the medial crura and sutured in place to the crura (open approach). The anterior end of the graft is rounded and shaved extremely thin to prevent visibility. The further the tip of the graft extends above the tip-defining points, the more it will tend to bend backward. If the bending is more than desired, a small rectangular block of cartilage can be sutured to the domes behind the graft. This results in increased stability and a barrier against bending upward with loss of tip projection and increased infratip lobular show.

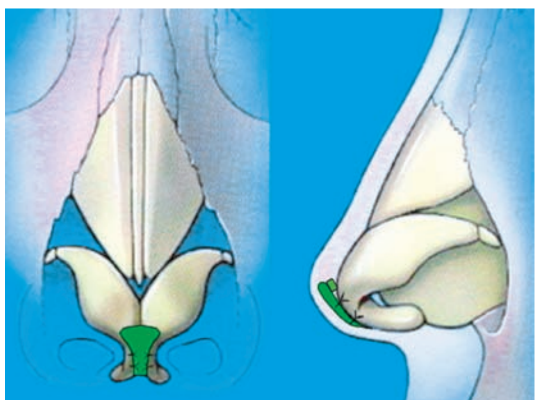
Onlay Tip Graft



An onlay tip graft is a single-layered or multi-layered graft placed horizontally over the alar domes.[18] It is placed in a tight pocket if the endonasal approach is used, or sutured for stabilization in the open approach. The graft functions to minimally increase tip projection but mainly to camouflage tip irregularities. The edges of the graft may be beveled or crushed to prevent postoperative visibility.

An onlay tip graft acts as the transverse component of an umbrella graft.

Shield Graft (Sheen or Infralobular Graft)



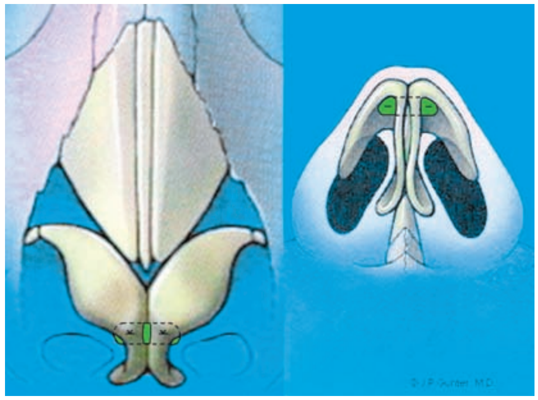
This shield-shaped graft is placed adjacent to the caudal edges of the anterior middle crura, extending into the tip.[19]

A shield graft is used to increase tip projection, define the tip, and improve contour of the infratip lobule.

Additional tip projection is obtained by moving the graft more anteriorly above the tip. If used with the endonasal approach, it is placed in a tightly undermined pocket for stabilization. If the open approach is used, it is sutured to the caudal

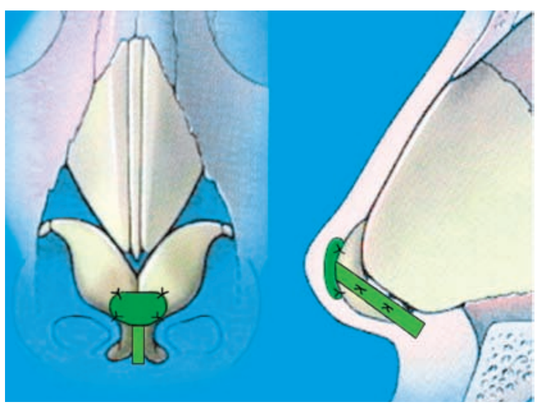
margins of the cartilage.[20] To prevent excessive cephalad tilting of the graft, a small block graft can be sutured to the alar domes to increase stability. The graft edges should be beveled or lightly morselized to make them softer and less visible.

Subdomal Graft



A subdomal graft is a bar-shaped graft placed in a pocket under the dome.[21] It corrects dome asymmetry by controlling the horizontal and vertical orientation of the domes. It may also be used to correct a pinched nasal tip deformity. Septal cartilage is the preferred graft material.

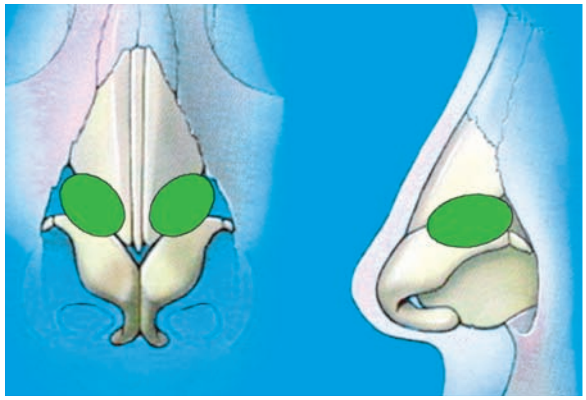
Umbrella Graft



An umbrella graft is composed of a vertical columellar strut combined with a horizontal onlay graft.[22] This graft is used in patients with both inadequate tip projection and support. The edges of the graft's transverse component should be beveled or morselized to prevent postoperative visibility. It is usually stabilized by placing the transverse component in a small, tight pocket (endonasal approach) or by suturing it to the domes of the lateral crura (open approach).

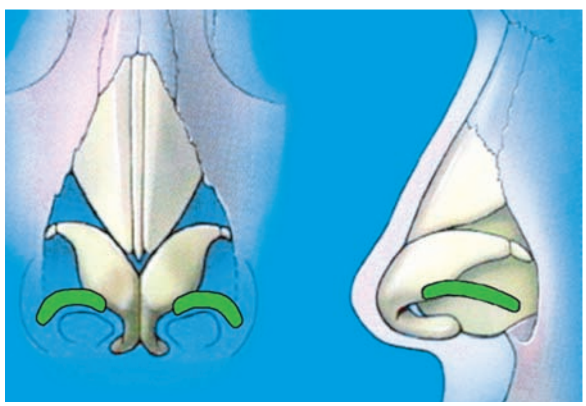
GRAFTS OF THE ALAR REGION

Alar Batten Grafts



Alar batten grafts are nonanatomic grafts placed in a pocket that extends from the piriform aperture to a paramedian position in the alar sidewall at the site of maximal lateral nasal wall collapse during inspiration.[23,24] The graft can be extended caudal to the area of the lateral crus to correct external valve dysfunction caused by loss of support from overresected lateral crura. Alternatively, it can be placed cephalad to the lateral crus to correct internal valve collapse.

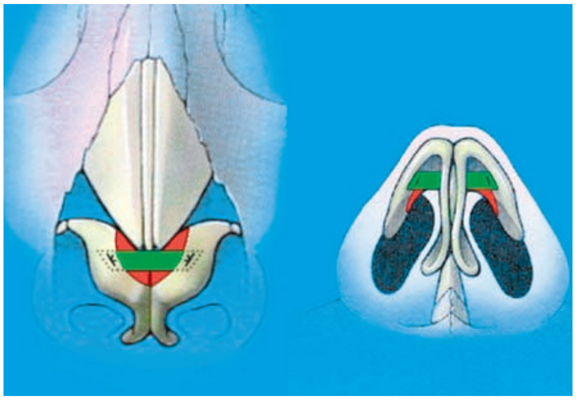
Alar Contour Grafts (Alar Rim Grafts)



Alar contour grafts are used to correct or prevent alar retraction or collapse.[25] They are placed in a subcutaneous pocket immediately above and parallel to the alar rim and must span the length of the alar deformity. The more severe the problem, the longer and wider the graft will need to be. Alar contour grafts are not as effective as lateral crural strut grafts in patients with significant alar scarring, loss of vestibular skin, or absent lower lateral cartilages.

Alar contour grafts are used to correct or prevent alar retraction or collapse.

Alar Spreader Graft (Lateral Crural Spanning Graft)

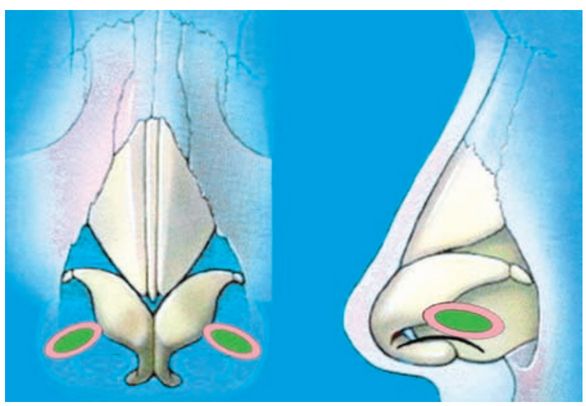


An alar spreader graft is a single bar graft that bridges the intercrural space, with the ends of the grafts placed in an undermined pocket between the lateral crura and vestibular skin.[26] The graft is sutured to the lateral crura for stabilization. It is used to correct or prevent a pinched nasal tip deformity by controlling the distance between and providing support to the lateral crura.

An alar spreader graft improves both external and internal valve dysfunction by correcting crural collapse.

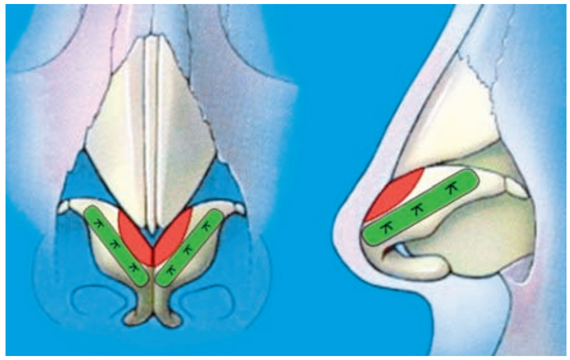
The shape (triangular or bar-shaped) and size of the graft will vary depending on the severity of the deformity.

Composite Alar Rim Graft



A composite alar rim graft is a composite skin–conchal cartilage graft that is harvested from the concha cymba or concha cavum and placed along the intranasal alar rim.[27,28] It is used to correct asymmetries in alar rim height and moderate to severe alar retraction or notching that is not amenable to other techniques, and to combat nostril or vestibular stenosis. The skin of the graft should be sutured to the edges of the defect in the vestibule. Percutaneous sutures are often employed to stabilize the graft. If the donor site cannot be closed primarily, it is closed with a full-thickness postauricular skin graft.

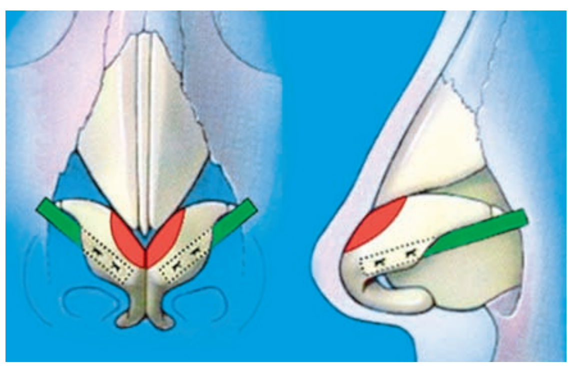
Lateral Crural Onlay Grafts



A lateral crural onlay graft is placed over the existing lateral crus.[29] It is used to correct alar contour irregularities caused by a deformed, intact lateral crus. These grafts strengthen and shape the ala and may improve external valve dysfunction. However, graft placement superficial to the lateral crus may be visible as a "step-off" at the anterior end and cephalic margin of the graft. The edges of the graft need to be carefully beveled.

The edge of a lateral crural onlay graft must be carefully beveled to prevent a step-off at the anterior end of the graft's cephalic margin.

Lateral Crural Strut Graft

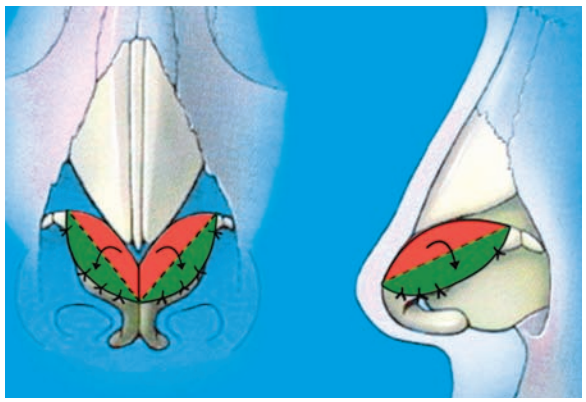


A lateral crural strut graft is placed in an undermined pocket between the undersurface of the lateral crus and the vestibular skin and stabilized by suturing to the crus.[30] It is used to correct alar retraction; alar rim collapse; and concave, convex, or malpositioned lateral crura. The lateral end of the graft is usually positioned superficial to the piriform aperture rim to prevent medial displacement of the graft.

The undermined lateral pocket should be inferior to the alar groove to prevent visibility of the end of the graft.

The more inferiorly the pocket is placed, the lower the alar rim will be displaced. Septal cartilage is the preferred source for grafting material, but costal cartilage may be required in graft-depleted patients.

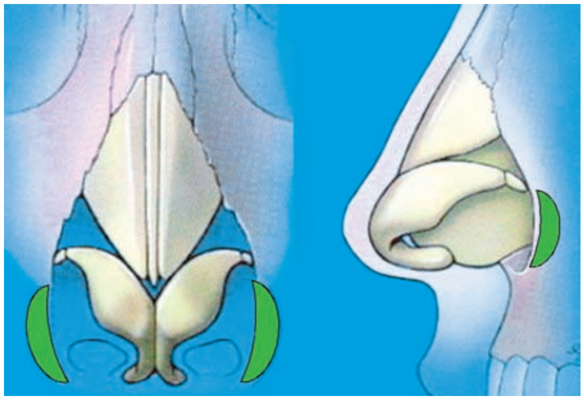
Lateral Crural Turnover Flap



A lateral crural turnover flap is created from the cephalic portion of the lateral crus after the vestibular skin has been undermined from its undersurface.[31] A partial-thickness incision is made on the undersurface of the lateral crus along its length so that the crus is halved longitudinally. This allows the graft to be turned superficial to the caudal segment so that it breaks but does not separate. The original cephalic margin of the crus is sutured to the caudal margin. Lateral crural turnover flaps are used to increase the strength of the lateral crura or to straighten convex or concave lateral crura. The thicker and stronger the lateral crus, the more effective the flap.

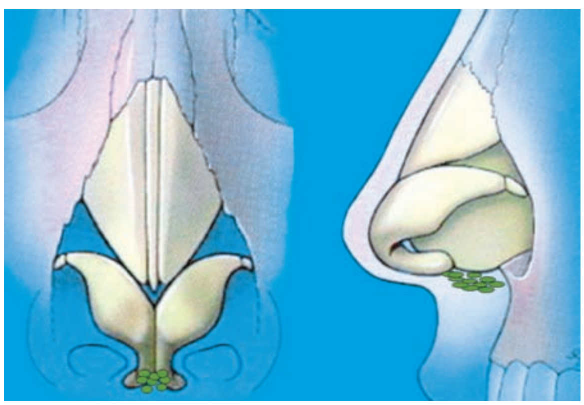
GRAFTS OF THE ALAR BASE

Alar Base Graft



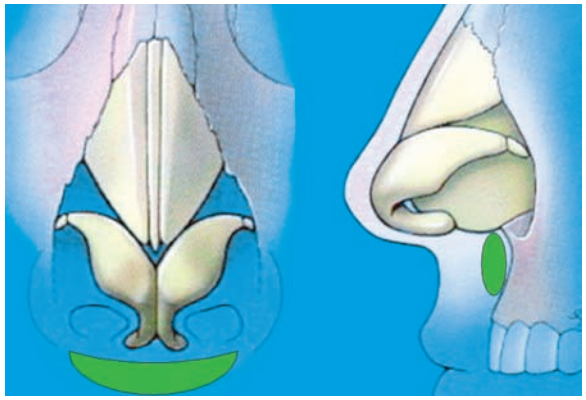
An alar base graft is placed along the lateral piriform aperture to augment a recessed lip–alar base junction. Carved cartilage grafts have been used but are difficult to shape and stabilize. Although some surgeons still use these grafts, others prefer hydroxyapatite granules or other alloplastic implants.[32]

Columellar Plumping Grafts



Columellar plumping grafts usually consist of diced or morselized cartilage and are placed in the space between the medial crural footplates and the nasal spine. Their purpose is to augment an inadequate columellar-labial angle or to correct minor posterior columellar contour deformities.

Premaxillary Graft



A premaxillary graft is typically placed along the caudal border of the piriform aperture.[33] It is used to correct premaxillary recession. These grafts are difficult to carve and stabilize, and many surgeons prefer to use alloplastic material.

KEY POINTS

- Maintenance of the major supporting structures of the nose is fundamental for aesthetic and functional purposes.
- Failure to maintain or furnish needed support results in suboptimal results, with deformities that are challenging to correct.
- The shapes, position, and usage of grafts vary depending on the situation and the desires of the surgeon.
- Septal cartilage is the preferred source for minimal to moderate augmentation with a dorsal onlay graft, but costal cartilage usually is required for large augmentations.
- The shape and thickness of a radix graft will depend on the amount of augmentation desired.
- Spreader grafts are used to restore or maintain the internal nasal valve, straighten a deviated dorsal septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity.
- Anchor grafts may be used to improve tip support and/or projection and collapse or deformation of the lateral crura.
- An onlay tip graft acts as the transverse component of an umbrella graft.
- A shield graft is used to increase tip projection, define the tip, and improve contour of the infratip lobule.
- Alar contour grafts are used to correct or prevent alar retraction or collapse.

- An alar spreader graft improves both external and internal valve dysfunction by correcting crural collapse.
- The edge of a lateral crural onlay graft must be carefully beveled to prevent a step-off at the anterior end of the graft's cephalic margin.
- The undermined lateral pocket should be inferior to the alar groove to prevent visibility of the end of the graft.

ACKNOWLEDGMENTS

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12

Harvesting Autologous Grafts for Primary Rhinoplasty

Rod J. Rohrich ▪ Stefan O.P. Hofer ▪ Jamil Ahmad

Over the past few decades, the trend in rhinoplasty has shifted away from ablative techniques involving reduction or division of the osteocartilaginous framework to conserving native anatomy with cartilage-sparing suture techniques and augmentation of deficient areas to correct contour deformities and restore structural support. Consequently, there is a growing need for donor sites that provide sufficient and consistent amounts of cartilage to produce adequate grafts. Autologous cartilage is preferred, because it is usually accessible with relatively minimal morbidity, integrates well into the recipient site, and has a significantly lower rate of complications when compared to alloplastic materials.[1-4]

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Cartilage grafts for primary rhinoplasty are generally harvested from the nasal septum. Ear cartilage is less frequently used. In the vast majority of patients, these donor sites provide enough cartilage for adequate sculpting of the nasal framework. In cases that demand a significant amount of cartilage, it may be necessary to harvest rib cartilage. More recently, temporal fascia grafts have also found utility as an autologous graft material in rhinoplasty.

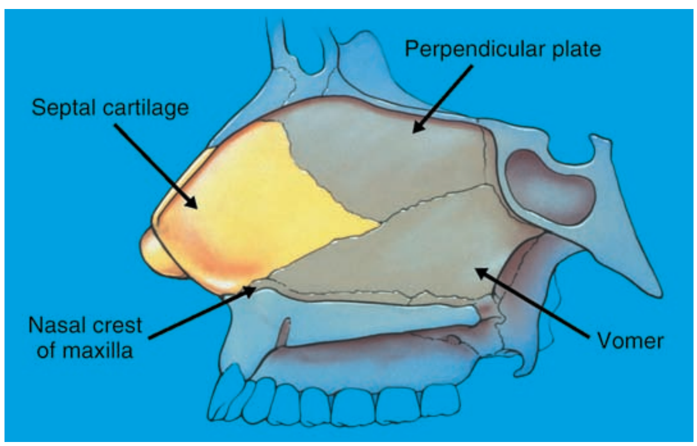
This chapter will focus on our preferred techniques for harvesting these cartilages and temporal fascia. When designing these procedures, special emphasis has been placed on decreasing donor site morbidity and its functional and aesthetic implications.

SEPTAL CARTILAGE

Septal cartilage is our primary choice for almost all grafts used in primary and secondary rhinoplasty for several reasons. First, it is already within the operative field, and therefore no additional incisions are necessary for harvesting the cartilage. Second, if the harvest is performed on a deviated segment of septum, the patient's airway may be improved postoperatively.

Septal cartilage is the primary choice for almost all grafts used in primary rhinoplasty because it is already within the operative field and no additional incisions are necessary for harvesting the cartilage.

Operative Technique



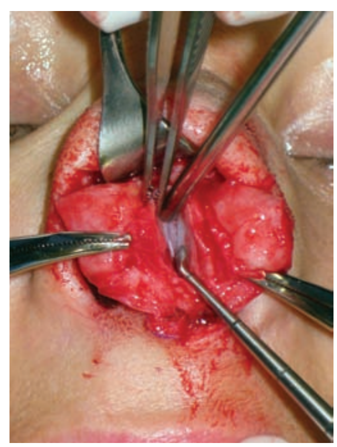
The cartilaginous septum is quadrangular in shape and bounded by three bones: the perpendicular plate of the ethmoid, the vomer, and the nasal crest of the maxilla. Therefore releasing the required cartilage from these structures is necessary for adequate harvesting of the septum. During closed rhinoplasty, access for septal harvest can be obtained through a hemitransfixion incision or a Killian incision. A full transfixion incision should be avoided, because 2 to 3 mm of tip projection can be lost, particularly when the dissection is carried down over the anterior nasal spine. Alternatively, the open approach can provide extensive exposure of the septum, facilitating septal harvest.

In our practice, the open approach is preferred because of the improved visualization it affords and the ease of harvesting large quantities of septal cartilage. If reduction of the dorsum is indicated, this should be done before septal harvest to ensure that an adequate L-strut is preserved. If the septal harvest is performed before dorsal reduction, any further excision of cartilage will decrease the width of the L-strut to less than what is required, weakening the remaining support and increasing the potential for deformities from lack of support, such as a saddlenose deformity.

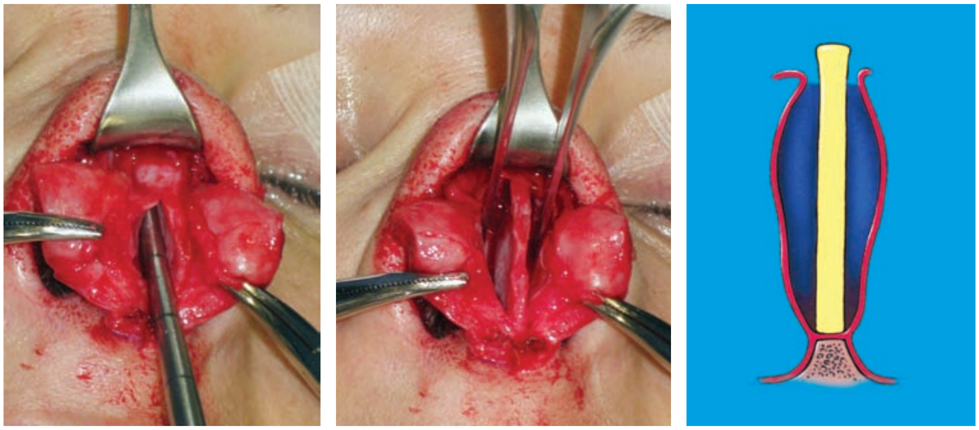
If reduction of the dorsum is indicated, this should be done before septal harvest to ensure that an adequate L-strut is preserved.

After separating the suspensory ligament between the medial crura, the anterior septal angle is identified. A scalpel is used to score the perichondrium about 3 mm posterior to the anterior septal angle until the underlying cartilage is exposed.

Initially a Cottle elevator is used to elevate the mucoperichondrial flap in a posterior and superior direction. This submucoperichondrial plane is identified by the distinct gray-blue appearance of the cartilage, the gritty feel of it, and the relative lack of resistance. Once in the submucoperichondrial plane, dissection proceeds quite easily. If there is resistance, this is usually because the plane of dissection is slightly superficial, and the perichondrium should be scored again so the flap can be elevated in the correct plane. Elevation of the mucoperichondrial flap in a superficial plane will lead to a greater chance of mucosal perforations.



The submucoperichondrial plane is identified by the distinct gray-blue appearance of the cartilage, the gritty feel of it, and the relative lack of resistance.



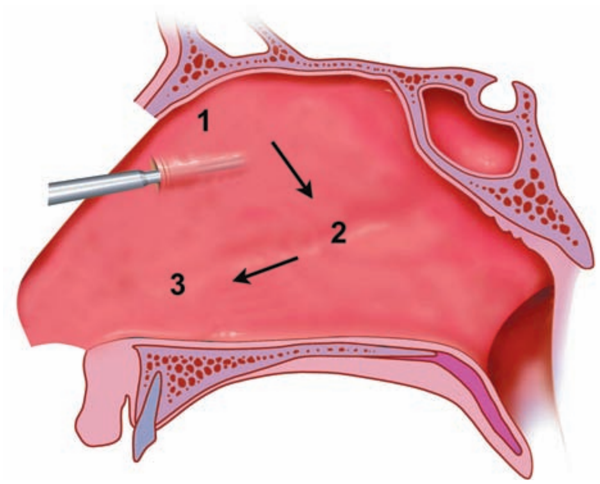
Bilateral submucoperichondrial tunnels are dissected deep to the upper lateral cartilages and a scalpel is used to separate the upper lateral cartilages from the dorsal septum. Release of the upper lateral cartilages from the dorsal septum allows direct visualization of the entire dissection. The submucoperichondrial dissection should be continued bilaterally to release the entire quadrangular cartilage. At the junction of the cartilaginous septum with the bony septum, dissection becomes more difficult because of crossed perichondrial and periosteal fibers, and care should be taken not to perforate the mucoperichondrial flaps.

Small unilateral mucosal perforations typically do not require repair. If large perforations or bilateral opposing perforations occur, they should be repaired using 5-0 chromic gut absorbable sutures. Repair of large or posterior perforations can be technically challenging because of the tight working space. In some cases, it may be necessary to place an interposition graft of cartilage, fascia, or allografts such as acellular dermal matrix to prevent bilateral opposing perforations to heal together, developing a septal perforation. In these cases, septal splints should be left in place for 2 to 3 weeks to allow reepithelialization of the interposition graft.

Small unilateral mucosal perforations typically do not require repair. If large perforations or bilateral opposing perforations occur, they should be repaired.

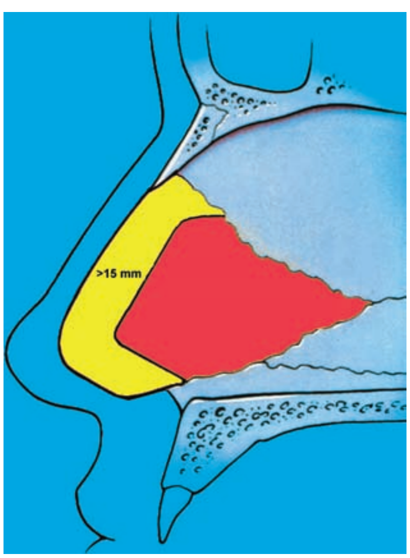
The dissection is continued inferiorly and posteriorly over the posterior vomer. The junction of the perichondrium with the periosteum overlying this region is

particularly difficult to dissect and should be performed with great care. It may be helpful to dissect two separate tunnels, one subperichondrial and one subperiosteal, and to divide the junction sharply to avoid tears in this region.



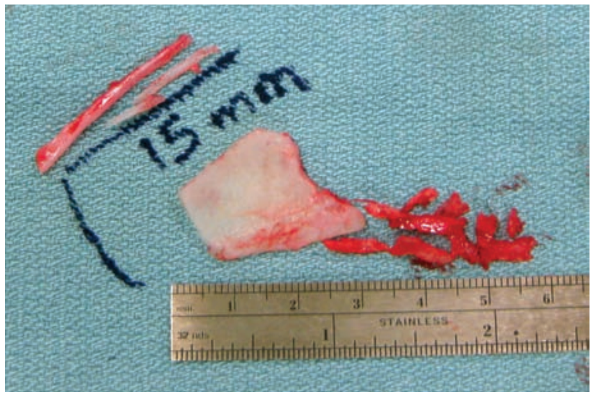
In cases of septal deviation, the mucoperichondrium on the convex side of the deviation is typically attenuated and more fragile making dissection more difficult; mucosal perforations occur more readily on this side. On the concave side of the deviation, dissection is generally more straightforward, and the surgeon should be especially careful to avoid any mucosal perforations on this side.

In cases of septal deviation, the mucoperichondrium on the convex side of the deviation is typically attenuated and more fragile making dissection more difficult; mucosal perforations occur more readily on this side.



When the septal cartilage is harvested, an incision is made parallel to the anterior edge of the septum, from the junction of the dorsal L-strut with the perpendicular plate of the ethmoid to the junction of the caudal L-strut with the maxillary crest. The width of the L-strut is determined by the strength of the cartilage. The dorsal and caudal L-strut should be at least 10 mm, but in many instances a width of 15 mm or more may be required to ensure long-term support. The L-strut should remain attached to the perpendicular plate at the keystone area and the nasal spine–maxillary crest area. In addition, curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut as well as between the dorsal and caudal L-strut can help to strengthen the construct.

In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength.



The septal cartilage is then disarticulated from its posterior osteocartilaginous junctions with the perpendicular plate of the ethmoid, vomer and maxillary crest using a Cottle elevator. The septal cartilage can then be removed with ease.

If there is deviation of the bony septum or septal spurs, the septum can be microfractured and returned to the midline. Microfracture of the septum should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. This is particularly important in posttraumatic cases where there may have been a prior septal fracture. Bony spurs of the septum can be removed using Takahashi forceps. Septal cartilage or bone should be removed with ease; if there is any resistance, residual soft tissue attachments should be completely released.

Microfracture of the septum should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. This is particularly important in posttraumatic cases where there may have been a prior septal fracture.

During these maneuvers, it is important to avoid pressure on the L-strut so that damage to the L-strut does not occur.

It is important to keep a record of the amount of cartilage harvested from the septum, and any excess material should be banked posterior to the L-strut for use during possible subsequent procedures.

At the end of the operation, Doyle septal splints (Micromedics Inc., St. Paul, MN) are placed. It is often necessary to trim the superior edge of the splints so they can be inserted and removed easily. The splints are lubricated with antistaphylococcal antibiotic ointment and secured with a single through-and-through 3-0 nylon horizontal mattress suture tied loosely to avoid strangulation of the septum as the tissues swell in the postoperative period. The goals are to avoid hematomas between the mucoperichondrial flaps, to support and stabilize the septal structures in the midline, to protect the mucosa, and to prevent the formation of synechiae by opposition of adjacent mucosal surfaces. Typically, the splints are removed after 5 to 7 days. Nasal packing is not routinely performed.

EAR CARTILAGE

Ear cartilage can provide a surprisingly large volume of graft material.[5] Given its flaccidity and the convolutions inherent in its structure, ear cartilage is ideal for reconstructing the lower lateral cartilages. It is most frequently used in secondary rhinoplasty, when the septum has previously been harvested but has limited utility when structural support is mandatory. However, harvest of ear cartilage may be required during primary rhinoplasty to reinforce the lower lateral cartilages or to extend support into the lateral nasal ala, which is not supported by

cartilage but merely contains fibrofatty tissue. In harvesting ear cartilage, the entire conchal bowl can be harvested without resulting in any contour deformity of the ear as long as the antihelix is not disturbed. Despite this, it is possible to harvest a significant length of cartilage.

Ear cartilage may be harvested through anterior or posterior approaches. The scar resulting from its harvest is very well concealed, even when placed anteriorly within the conchal bowl. An anterior approach provides clear visualization of the exact area of cartilage to be harvested, making this a very precise procedure.

Given its flaccidity and the convolutions inherent in its structure, ear cartilage is ideal for reconstructing the lower lateral cartilages.

Operative Technique for the Anterior Approach

The anterior approach can be used when either a small or a large piece of cartilage is required. The anterior approach provides excellent exposure and is especially useful when a very large piece of cartilage is required.

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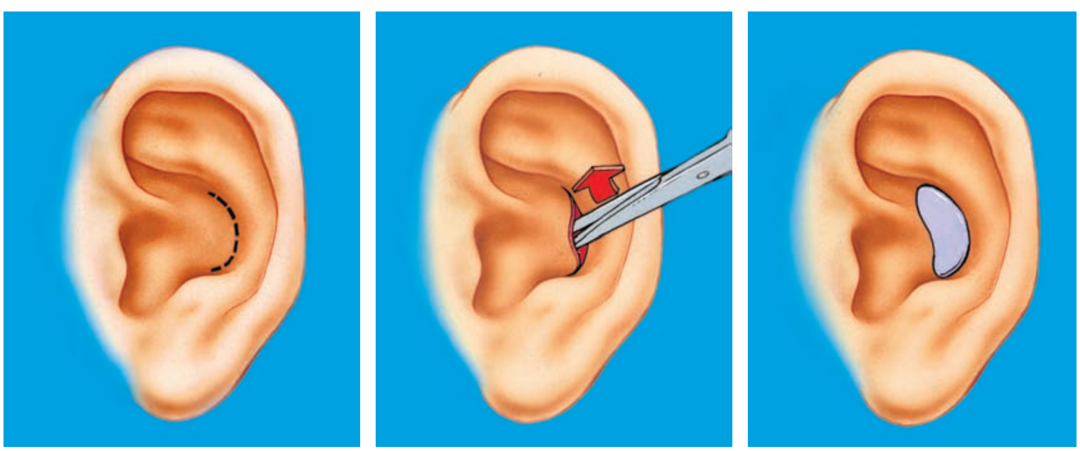


The incision is placed approximately 3 mm inside of the conchal bowl both to camouflage the scar within the concha and preserve the antihelix to prevent contour deformities of the ear. Before the incision is made, the concha is infiltrated from the anterior and posterior sides with 2 to 3 ml of 1% lidocaine with

epinephrine. In addition to hemostasis, this is used to hydrodissect the proper plane of dissection.

The initial incision is made with a No. 15 blade, and after two single hooks are placed for traction on the skin edge, the remaining dissection is performed with curved, fine-tipped scissors. The tips of the scissors should be pointed toward the skin to prevent inadvertent scoring of the cartilage during dissection that would damage the graft material.

The incision is placed approximately 3 mm inside of the conchal bowl both to camouflage the scar within the concha and preserve the antihelix to prevent contour deformities of the ear.

Once the skin has been elevated from the anterior aspect of the conchal bowl, a full-thickness cut is made at the level of the initial skin incision and extending through the posterior perichondrium. Scissors are used to dissect the posterior perichondrium off the postauricular skin. Again, the tips of the scissors are pointed toward the skin. The harvest is completed by incising the cartilage as far medially as required. Typically, the maximal medial extent of harvest should not involve the cartilage of the external auditory meatus. Hemostasis is obtained and closure is accomplished using a running 5-0 plain gut suture.

A cotton and petrolatum gauze tie-over bolster on the anterior and posterior sides is used to obliterate the resulting dead space and prevent hematoma formation. This is secured by placing a 3-0 nylon suture through the anterior and posterior skin; the suture is normally removed after 1 to 3 days.

Operative Technique for Posterior Approach

If the surgeon prefers, ear cartilage can be harvested through a posterior approach. The incision may be placed parallel to and just lateral to the conchal bowl. A large piece of cartilage can also be harvested through this approach. However, when a large graft is required, it becomes more challenging to assess the maximal extent of harvest (mainly preservation of the antihelix) to prevent contour deformities of the ear.

A 25-gauge needle is used to mark the amount of cartilage to be harvested. This is performed by passing the needle from anterior to posterior through the cartilage after tingeing it with methylene blue.

When tattooing the cartilage, it is important to preserve at least 3 mm of conchal bowl cartilage adjacent to the antihelix, a shoulder of cartilage inferiorly at the insertion with the incisura intertragica, and another shoulder of cartilage superiorly at the root of the antihelix. Leaving these structures intact is essential to avoid a noticeable donor site deformity after harvesting of the cartilage.

The posterior and anterior auricular skin over the cartilage to be harvested is infiltrated with 1% lidocaine with epinephrine. The posterior auricular incision is made through skin only, and the skin is dissected from the conchal bowl using curved fine-tip scissors. During dissection the scissor tips are always directed away from the cartilage to prevent inadvertent cartilage scoring. Once the conchal bowl is completely dissected, the cartilage is incised using a No. 15 blade along the methylene blue marks. With the use of a single hook for traction, the conchal bowl cartilage is dissected from the anterior skin. The resection is completed with another full-thickness incision through the medial conchal bowl, taking care not to perforate the anterior conchal bowl skin.

Again, hemostasis is obtained and closure is performed with a running 5-0 plain gut suture.

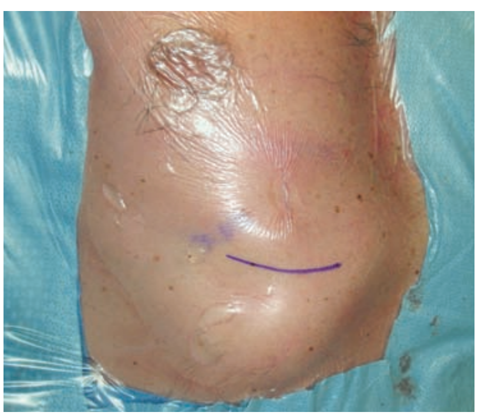
As before, a cotton and petrolatum gauze tie-over bolster is used to obliterate the resulting dead space and prevent hematoma formation.

RIB CARTILAGE

In cases that demand a significant amount of cartilage, it may be necessary to harvest rib cartilage.[6-10] If septal cartilage is inadequate, rib cartilage is preferred over ear cartilage when grafts for structural support are required.

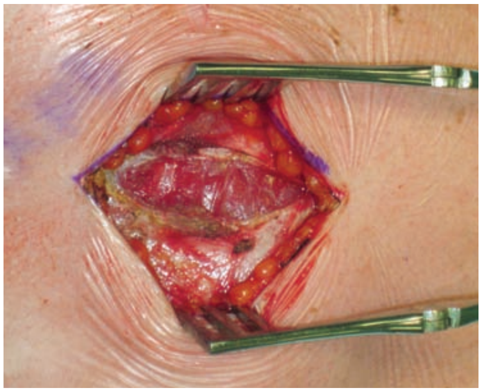
When septal cartilage is inadequate, rib cartilage is preferred over ear cartilage when grafts for structural support are required.

Operative Technique

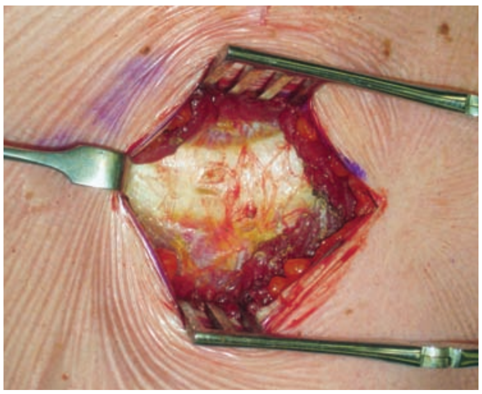


The fifth, sixth, and seventh ribs are preferred. An incision approximately 4 to 6 cm long is placed directly over the junction of these ribs. In a female patient, the scar can also be designed to lie in the inframammary fold, which makes a very inconspicuous donor site. Once the subcutaneous tissues have been incised, it is possible to use retractors to obtain more exposure of the ribs while limiting the size of the skin incision.

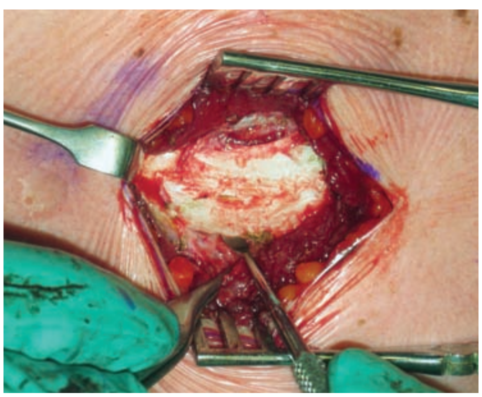
In a female patient, the scar from harvest of rib cartilage can also be designed to lie in the inframammary fold, which makes a very inconspicuous donor site.



A No. 15 blade is used to incise the skin, and needle-tip electrocautery is used to dissect to the deep fascia. Before incising through the deep fascia, the underlying rib is palpated to verify that the incision is directly over cartilage and oriented along its longitudinal axis.

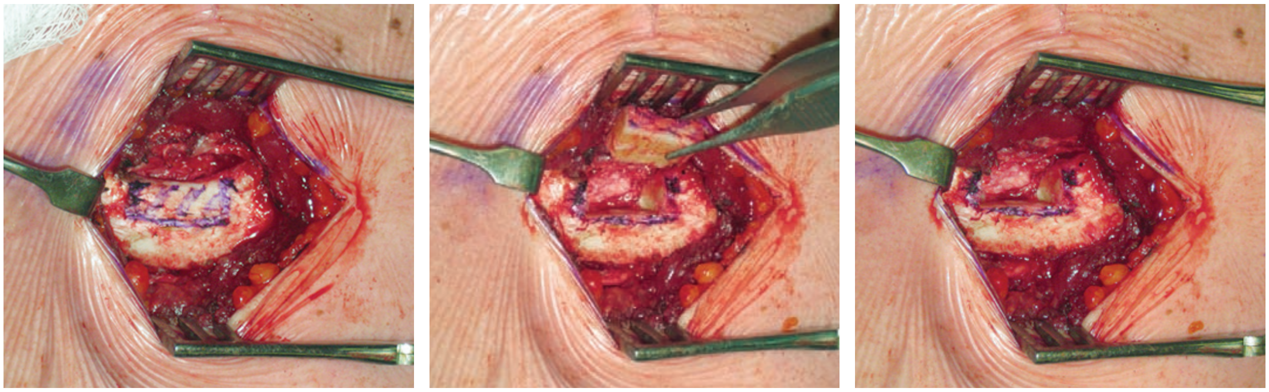


Once the rib is exposed, the perichondrium is incised with needle-tip electrocautery.



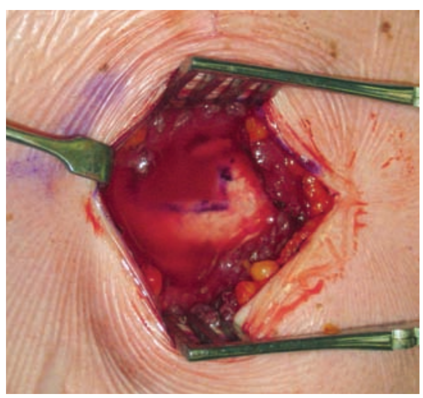
A periosteal elevator is used to dissect the perichondrium off the anterior surface of the rib cartilage. This dissection is continued around the superior and inferior surfaces of the rib. The posterior dissection is completed using a rib elevator or small periosteal elevator.

To maximize the length of rib harvested, dissection should extend to the osteocartilagenous junctions medially and laterally. A No. 15 blade is used to incise through the medial and lateral rib cartilage to free the cartilage. There may still be some attachments remaining posteriorly, and these should be released with the periosteal elevator.



The amount of cartilage required will dictate whether cartilage from one or more ribs is harvested. If only a small amount of cartilage is required, it is possible to harvest the superior half of the rib cartilage, leaving the inferior half of the cartilage behind.[11] Thus the continuity of the rib remains intact, which will be beneficial for the patient's recovery, since this generally causes less postoperative pain compared with a procedure in which the rib's continuity is compromised.

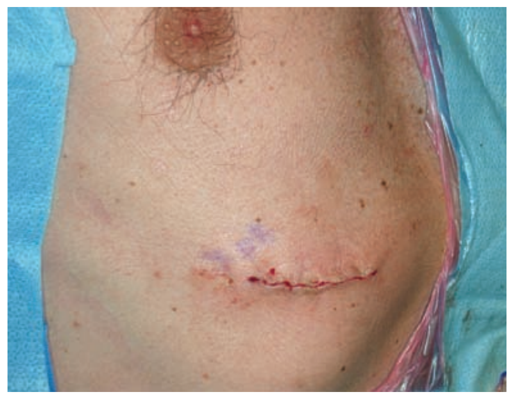
If only a small amount of cartilage is required, it is possible to harvest the superior half of the rib cartilage, leaving the inferior half of the cartilage behind.



Hemostasis is obtained, and before closure, the donor site is inspected to ensure that no pneumothorax has occurred. The wound is filled with saline solution and positive-pressure ventilation is given by the anesthesiologist. Bubbles will be seen if there has been a violation of the parietal pleura. If there has been a breach of the parietal pleura, careful inspection of the area is required to identify the air

leak. Once the air leak has been identified, the surgeon must decide whether a suture closure should be attempted. Generally, the pleura is very fragile and does not tolerate larger needles or tension with a suture. Rather than enlarging the existing leak, the tissues around the leak are assessed. Often a small turnover flap from surrounding fascia or periosteum can be used to seal the defect off. If no appropriate tissues are adjacent to the perforation, a small piece of periosteum can be harvested and used as an onlay repair. Before putting in the last stitch in any repair, positive airway pressure should be given to fully expand the lungs.

Before closure, the rib cartilage donor site is inspected to ensure that no pneumothorax has occurred.

In the absence of a pneumothorax, the fascia and skin are closed in layers using 2-0 Vicryl sutures in the fascial layer, followed by 4-0 Monocryl inverted deep dermal sutures and a running intradermal suture.

TEMPORAL FASCIA

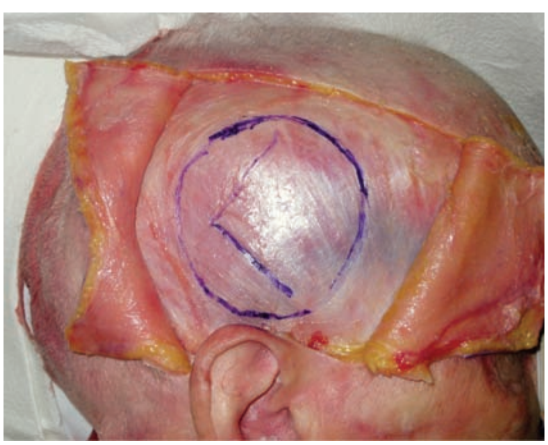
Recently, temporal fascia grafts have found utility as an autologous graft material in rhinoplasty for camouflage or as composite grafts, such as diced cartilage grafts wrapped in temporal fascia.[11-13] Temporal fascia can be harvested with minimal donor site morbidity and an inconspicuous scar in the temporal scalp.

Temporal fascia grafts have found utility as an autologous graft material in rhinoplasty for camouflage or as composite grafts, such as diced cartilage grafts wrapped in temporal fascia.

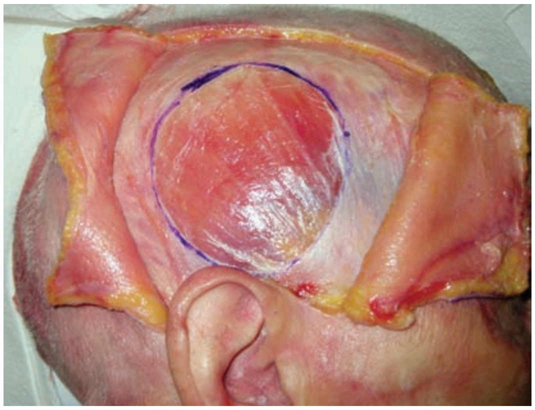
Operative Technique

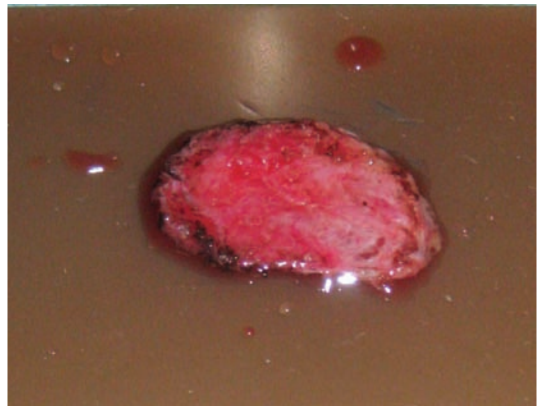
The anterior limit of the incision is made in line with the tragus. A posterior-pointing, V-shaped incision is used, because this gives the widest exposure for the subcutaneous dissection. The incision is approximately 5 cm in craniocaudal dimension and spans approximately 2.5 cm in anteroposterior dimension. The skin of the scalp is infiltrated with 5 ml of 1% lidocaine with epinephrine. It is unnecessary to clip the hair of the incision. Instead, hemostats can be used to clamp the hair and expose the skin where the incision is to be made. A No. 15 blade is used to incise the skin down through the temporoparietal fascia to expose the deep temporal fascia. Needle-tip electrocautery is used to dissect the areolar tissues off the superficial surface of the deep temporal fascia.

A posterior-pointing, V-shaped incision is used to harvest temporal fascia, because this gives the widest exposure for the subcutaneous dissection.



The surgeon should attempt to harvest the largest piece of temporal fascia possible. This involves incising the temporal fascia close to the temporalis muscle's attachments to the skull periosteum superiorly and posteriorly and where it begins to divide into deep and superficial layers anteriorly. The temporal fascia should be harvested inferiorly to the level of the ear.





Although this area is about 8 by 6 cm in dimension, temporal fascia contracts significantly, and this generally yields a temporal fascia graft that is about 5 by 4 cm in dimension. The deep temporal fascia is incised with needle-tip electrocautery and then swept off the underlying temporalis muscle. Muscle fibers should not be harvested with the temporal fascia graft. Hemostasis is obtained, and the skin is closed in layers with 3-0 Vicryl inverted deep dermal sutures, followed by a running 4-0 chromic gut suture.

An attempt should be made to harvest the largest piece of temporal fascia possible, because temporal fascia contracts significantly.

KEY POINTS

- Autologous cartilage is preferred, because it is usually accessible with relatively minimal morbidity, integrates well into the recipient site, and has a significantly lower rate of complications when compared with alloplastic materials.
- Septal cartilage is the primary choice for almost all grafts used in primary rhinoplasty because it is already within the operative field and no additional incisions are necessary for harvesting the cartilage.
- If reduction of the dorsum is indicated, this should be done before septal harvest to ensure that an adequate L-strut is preserved.
- The submucoperichondrial plane is identified by the distinct gray-blue appearance of the cartilage, the gritty feel of it, and the relative lack of resistance.
- Small, unilateral mucosal perforations typically do not require repair. If large perforations or bilateral opposing perforations occur, they should be repaired.
- In cases of septal deviation, the mucoperichondrium on the convex side of the deviation is typically attenuated and more fragile making dissection more difficult; mucosal perforations occur more readily on this side.

- In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength.
- Microfracture of the septum should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. This is particularly important in posttraumatic cases where there may have been a prior septal fracture.
- Given its flaccidity and the convolutions inherent in its structure, ear cartilage is ideal for reconstructing the lower lateral cartilages.
- The anterior approach provides excellent exposure and is especially useful when a very large piece of cartilage is required.
- The incision is placed approximately 3 mm inside of the conchal bowl both to camouflage the scar within the concha and preserve the antihelix to prevent contour deformities of the ear.
- When septal cartilage is inadequate, rib cartilage is preferred over ear cartilage when grafts for structural support are required.
- In a female patient, the scar from harvest of rib cartilage can also be designed to lie in the inframammary fold, which makes a very inconspicuous donor site.
- If only a small amount of cartilage is required, it is possible to harvest the superior half of the rib cartilage, leaving the inferior half of the cartilage behind.
- Before closure, the rib cartilage donor site is inspected to ensure that no pneumothorax has occurred.
- Temporal fascia grafts have found utility as an autologous graft material in rhinoplasty for camouflage or as composite grafts, such as diced cartilage grafts wrapped in temporal fascia.
- A posterior-pointing, V-shaped incision is used to harvest temporal fascia, because this gives the widest exposure for the subcutaneous dissection.
- An attempt should be made to harvest the largest piece of temporal fascia possible, because temporal fascia contracts significantly.

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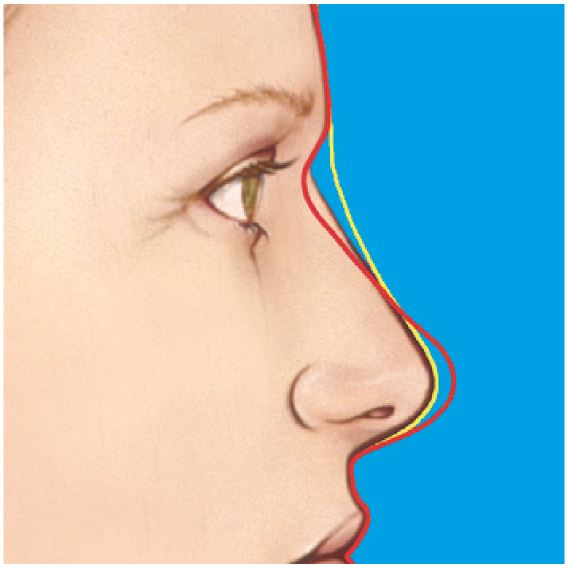
PART THREE

The Dorsum



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Evaluation and Surgical Approach to the Nasal Dorsum: Component Dorsal Hump Reduction and Dorsal Reconstitution

Rod J. Rohrich ▪ Jamil Ahmad ▪ Jason Roostaeian

Manipulation of the nasal dorsum, and in particular dorsal hump reduction, is commonly performed during rhinoplasty.[1] This largely stems from the fact that achieving an aesthetically pleasing dorsal nasal profile is one of the most common goals among patients seeking rhinoplasty. However, significant morbidity can result when dorsal hump reduction is performed without sufficient emphasis on the anatomic and functional relationships of the dorsum. Some of the more significant adverse outcomes of dorsal hump reduction include the following:

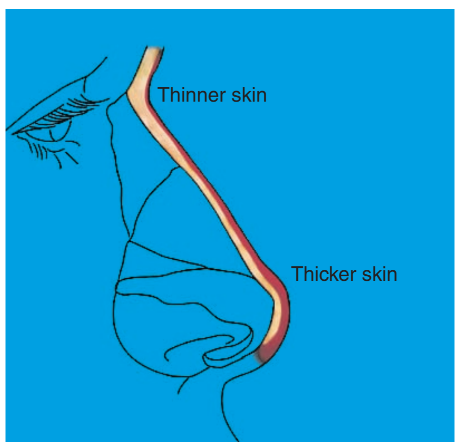
- Long-term dorsal irregularities, commonly at the osteocartilaginous transition zone, secondary to uneven hump reduction
- Overresection or underresection of the osteocartilaginous hump
- Excessive narrowing and/or widening of the midvault secondary to aggressive hump reduction, nasal osteotomies, and improper reconstitution of the upper lateral cartilages[2-5]
- Inverted-V deformity secondary to excessive resection or avulsion of the upper lateral cartilages[2,3,6,7]
- Asymmetries and/or irregularities of the dorsal aesthetic lines secondary to nasal osteotomies and poor reconstitution of the nasal dorsum[3,4,8,9]

Chapter excerpted from Rohrich RJ, Muzaffar AR, Janis JE. Component dorsal hump reduction: the importance of maintaining dorsal aesthetic lines in rhinoplasty. Plast Reconstr Surg 114:1298-1308, discussion 1309-1312, 2004; Roostaeian J, Unger J, Lee MR, Geissler PJ, Rohrich RJ. Reconstitution of the nasal dorsum following component dorsal reduction in primary rhinoplasty. Plast Reconstr Surg. 2013 Nov 20. [Epub ahead of print]; and Geissler PJ, Roostaeian J, Lee MR, et al. Role of upper lateral cartilage tension-spanning suture in restoring the dorsal aesthetic lines in rhinoplasty. Plast Reconstr Surg (in press).

These potential complications can often be avoided when the surgeon has a complete understanding of the anatomy of the nasal dorsum and its relationship to nasal aesthetics and function. A component dorsal hump reduction technique has been developed that takes into consideration anatomic, aesthetic, and functional relationships.[3,6] This technique emphasizes a graduated approach to nasal hump reduction that is both adaptable and reproducible. Although preservation of the upper lateral cartilages is a fundamental step when addressing the nasal dorsum, it must be accompanied by proper restoration of the midvault and dorsal aesthetic lines. Therefore correct positioning and contour of upper lateral cartilages following their detachment from the nasal septum is also critical to avoid functional and aesthetic complications.[4,5]

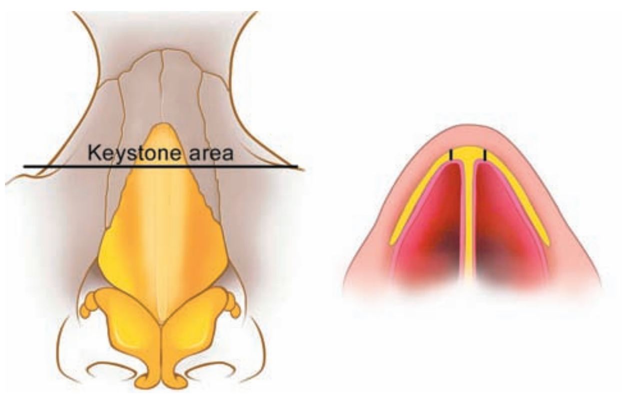
A graduated approach is critical, with preservation and proper reconstitution of upper lateral cartilages when reducing a dorsal hump.

ANATOMIC CONSIDERATIONS



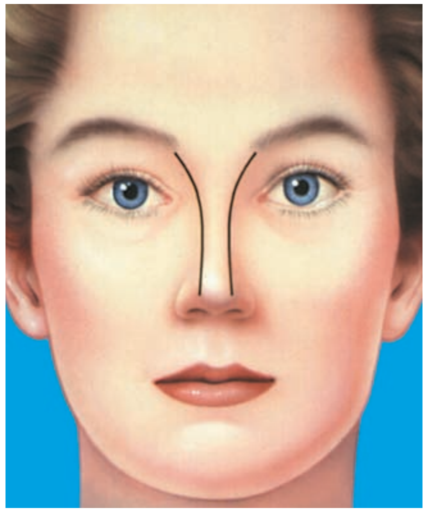
The thickness of the skin of the nasal dorsum varies; it is thinner in the dorsum and thicker in the supratip and tip regions.[6] Therefore a straight dorsal profile must account for this variation in dorsal skin thickness by creating a slight underlying convexity of the osteocartilaginous framework in the cephalic area.

The underlying osteocartilaginous nasal framework consists of three separate vaults: bony, upper cartilaginous, and lower cartilaginous. The bony vault is created by the paired nasal bones and the ascending frontal process of the maxilla, constituting the proximal one third to one half of the nose. The nasal bones are narrowest and thickest above the canthal level.



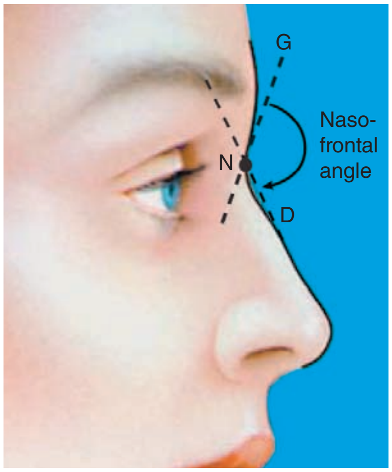
The nasal bones overlap the upper lateral cartilages typically for distance of 4 to 6 mm at the keystone area, which should be the widest part of the dorsum.[6] The relationship of the upper lateral cartilages to the septum is critical both functionally and aesthetically. Maintaining the T-shaped contour of the dorsum prevents internal valve collapse and inverted-V deformities. This contour of the nasal dorsum, in particular its keel-shaped segment, must be maintained or reconstructed in rhinoplasty or nasal reconstruction.

AESTHETICS OF THE NASAL DORSUM

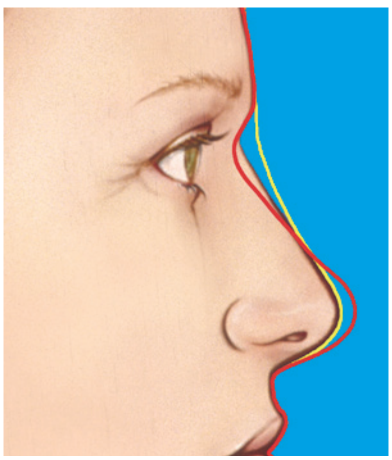


On frontal view, the character of the nasal dorsum is largely defined by the dorsal aesthetic lines.[6] These lines should be carefully maintained or recreated when performing dorsal reduction. The dorsal aesthetic lines originate at the supraorbital ridges passing along the lateral borders of the glabella staying just medial to the medial canthal ligaments. They then diverge at the keystone area and go on to follow the junction between the nasal dorsum and sidewall, ultimately concluding at the tip-defining points. Ideally, the dorsal aesthetic lines should be symmetric with a smooth and continuous contour that matches either the interphiltral distance or tip-defining points in width. The upper lateral cartilages define the middle third of the dorsal aesthetic lines thereby playing an integral role in the overall contour and aesthetic result.[4,10]

Preservation or creation of dorsal aesthetic lines with a smooth, symmetrical, continuous contour is critical in rhinoplasty.

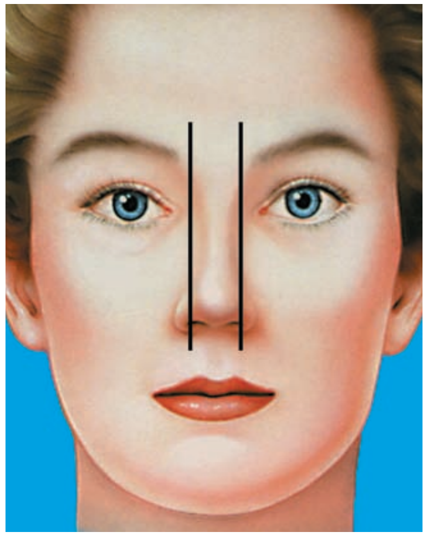


The shape of the radix is determined by the nasofrontal angle.[6] This angle is created by the intersection of a line passing through the soft tissue nasion *(N)* tangent to the infrabrow glabella *(G)* and a line drawn as a superior extension of the nasal dorsum *(D)*. Typically varying from 128 to 140 degrees, the nasofrontal angle is ideally 134 degrees in females and 130 degrees in males, but can also vary with ethnicity. The apex of the angle should lie between the upper lid eyelashes and the supratarsal fold. The nasion should be approximately 15 mm anterior to the medial canthus or 11 mm anterior to the corneal plane as measured on a lateral view.



The perceived length and projection of the nose on lateral view are directly influenced by the position of the radix.[6] If the radix is positioned more anteriorly and superiorly than normal, the nose will appear artificially elongated, the nasofacial angle will be decreased, and the tip projection will appear diminished *(yellow line)*. Conversely, if the radix is too posteriorly and/or inferiorly positioned, the nose will be made to appear shorter and the tip more projecting *(red line)*. The nasofacial angle ideally should measure 32 to 37 degrees and is defined by the junction of the dorsum with the vertical facial plane.[11]

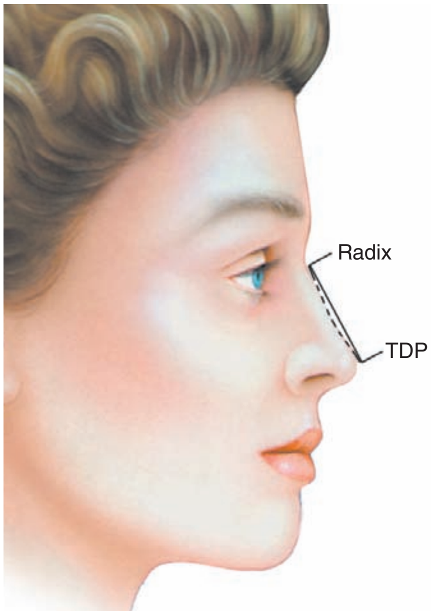
The radix is located between the supratarsal fold and the upper eyelid lashes, and its position affects the apparent length and projection of the nose on the lateral view.

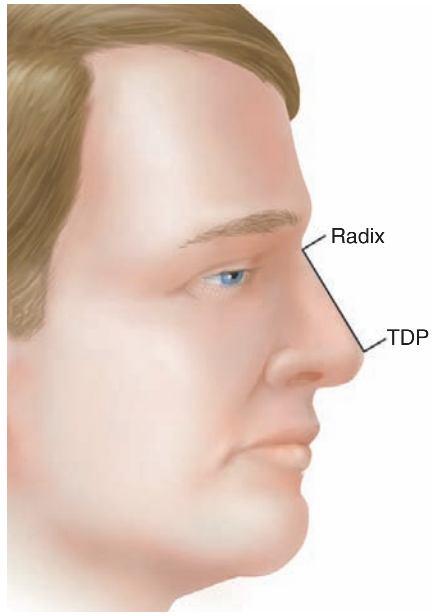


The width of the bony base of the osteocartilaginous vault should be equal to 75% to 80% of the intercanthal distance or normal alar base width.[6] Osteotomies are not indicated if this width is normal; however, when the bony base is wider than 80% of the intercanthal distance, osteotomies may be required to narrow the bony dorsum.

The width of the dorsum at the keystone area must be preserved. The width of the bony base should be equal to 75% to 80% of the intercanthal distance or normal alar base width.

Each of these aesthetic relationships must be carefully considered in the preoperative planning of the dorsal profile. The first step is to determine the preferred position of the nasofrontal angle on lateral view. Next, the desired amount of tip projection and degree of tip rotation should be determined.





In women, the new dorsal line on lateral view should lie slightly posterior to a line connecting the nasofrontal angle with the tip-defining points *(TDP)*. The dorsum should be slightly higher in men to avoid feminizing the nose.

In women, the dorsum should lie just below a line connecting the nasofrontal angle with the tip-defining points, whereas the dorsum should be no lower than this line in men to avoid feminizing the nose.

Any patient with a dorsal hump, defined by excess height above a line from the radix to the tip-defining points, is an appropriate candidate for component dorsal hump reduction.

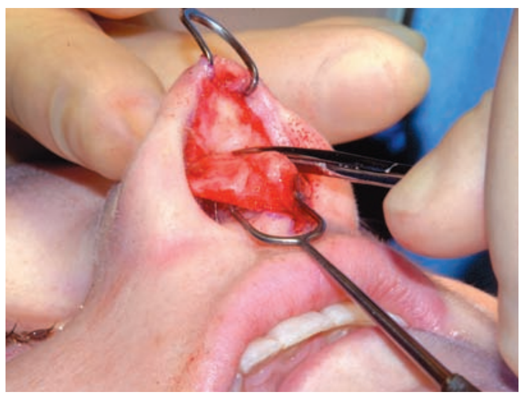
OPERATIVE TECHNIQUE

In primary rhinoplasty, the open approach is our preferred technique.[12] A closed, or endonasal, approach is used on occasion in the case of the isolated dorsal hump. Guided by a precise preoperative clinical analysis, we perform the initial modification of the dorsum before addressing the tip correction. This sequence establishes the balance between the tip and the dorsum that is crucial to an opti-

mal aesthetic result. Component dorsal hump reduction followed by dorsal reconstitution of the osteocartilaginous hump involves eight essential steps:

1. Dorsal undermining
2. Separation of the upper lateral cartilages from the septum
3. Incremental component dorsal septal reduction
4. Incremental dorsal bony reduction (using a rasp)
5. Incremental reduction of upper lateral cartilages (if indicated)
6. Three-point dorsal palpation test
7. Reconstitution of the dorsum with sutures (most common), spreader flaps, and/or spreader grafts (if indicated)
8. Medial/lateral osteotomies (if indicated)

1. Dorsal Undermining

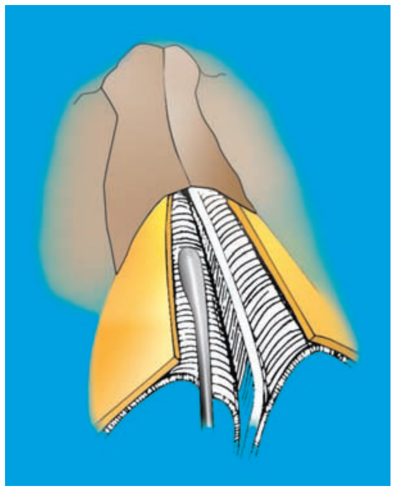


Meticulous skeletonization is used to expose the dorsal osteocartilaginous framework, maintaining the plane of dissection as close to the cartilaginous surfaces as possible. Dissection is continued subperiosteally over the bony vault. The periosteal layer protects against postoperative soft tissue adhesions and camouflages the reconstructed bony vault; care must be taken not to tear the periosteum excessively. Preservation of the lateral soft tissue and periosteal attachments to the bony sidewalls provides significant support and stability for the nasal pyramid after osteotomies have been performed; therefore lateral dissection must be limited to the amount necessary to allow access for bony hump reduction.

Preservation of the lateral soft tissue and periosteal attachments to the bony sidewalls provides significant support and stability for the nasal pyramid after osteotomies have been performed; therefore lateral dissection must be limited to the amount necessary to allow access for bony hump reduction.

Extensive undermining is needed only in older patients, patients with thick skin, and patients with a significant osteocartilaginous hump (greater than 5 mm). Care must be taken to avoid dissection under the nasal bones and detachment of the upper edge of the upper lateral cartilages. At times the surgeon must gently push the upper lateral cartilages down and out of the way to avoid inadvertent transection when reducing the septum and/or the bony dorsum.

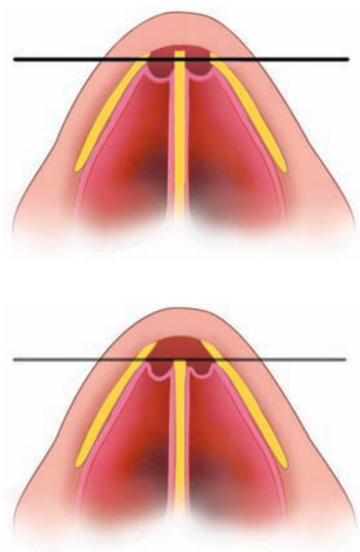
2. Separation of the Upper Lateral Cartilages From the Septum



Creating bilateral superior submucoperichondrial tunnels is essential before beginning the component reduction of the dorsal hump.[6] The mucoperichondrium of the dorsal septum is elevated, from caudal to cephalad, until the elevator reaches the nasal bones. The upper lateral cartilages can be sharply separated from their junction with the septum without damaging the mucosa. This maneuver also allows removal of the bony and cartilaginous hump while sparing the mucosa. Extramucosal resection of the bony and cartilaginous components is a critical concept; preservation of the mucosa reduces the potential for late cicatricial narrowing of the internal nasal valve and webbing of the vestibule. Furthermore, spreader grafts can then be placed in a closed space and dorsal grafts separated from the nasal cavity. Preservation of mucosal integrity also affords greater overall stability after septal reconstruction.

Creation of bilateral submucoperichondrial tunnels before component reduction of the dorsal hump prevents cicatricial narrowing of the internal nasal valve and webbing of the vestibule.

3. Incremental Component Dorsal Septal Reduction



Once the subperichondrial tunnels have been made and the transverse portions of the upper lateral cartilages have been separated from the septum using a No. 15 scalpel, a cartilaginous hump in three pieces results—the septum centrally and the transverse portions of the upper lateral cartilages laterally.[6] Dorsal hump reduction begins with the isolated central septum, using serial incremental resections of the septal cartilage with angled septal scissors under direct vision. It is important to preserve the upper lateral cartilages—equal resection of the upper lateral cartilages and septum results in rounding of the dorsum, whereas excessive resection of the dorsal edges of the upper lateral cartilages as compared with the septum results in an inverted-V deformity or an overly narrow midvault.

Excessive resection of the dorsal edges of the upper lateral cartilages can lead to an inverted-V deformity or an overly narrow midvault.

4. Incremental Dorsal Bony Reduction

A sharp, downbiting diamond rasp is used to reduce the osseous hump. Reduction of small and medium humps (5 mm or less) can usually be accomplished with incremental rasping. A slightly oblique bias should be maintained while rasping to minimize the risk of avulsion of the upper lateral cartilages or septum from the bony vault. Rasping should proceed along the left and right dorsal aesthetic lines and then centrally in a methodical fashion using controlled, short rasp excursions with the thumb and index finger of the nondominant hand used to stabilize the bony vault. Infrequently, a guarded 8 mm osteotome may be required to reduce larger bony humps. The osteotomy should proceed from the caudal edge of the nasal bones to the radix at or slightly above the level of the planned dorsum in a conservative manner. This is followed with a rasp for final bony adjustments. Alternatively, a power oscillating burr with a dorsal skin protector can be used under direct visualization to remove large cranial bony humps.

Reduction of the bony hump is most commonly carried out with a downbiting rasp; large humps may require a guarded osteotome or a power oscillating burr with a dorsal skin protector.

5. Incremental Reduction of Upper Lateral Cartilages

Only after reduction of the cartilaginous septal and bony dorsal components of the hump is reduction of the upper lateral cartilages considered. However, this may be unnecessary in some cases, and it is essential to avoid overresection of the upper lateral cartilages to prevent internal nasal valve collapse and long-term irregularity of the dorsum.[13,14] It is even more important to avoid this when short nasal bones and a high and narrow osteocartilaginous framework are noted preoperatively.[2]

Incremental reduction of the upper lateral cartilages is typically performed from either the dorsal edges with large hump reductions (greater than 5 mm) or from the caudal border of the upper lateral cartilages when one is attempting to shorten the nose and/or reduce lateral side wall fullness in the scroll area.

6. Three-Point Dorsal Palpation Test

Throughout the dorsal reduction procedure, it is crucial to repeat the three-point dorsal palpation test after each modification of the dorsum.[6] This test is performed with the dominant index fingertip, moistened with normal saline solution. The fingertip gently palpates the left and right dorsal aesthetic lines and then palpates centrally to detect any dorsal irregularities or contour depressions.

Maintaining the appropriate height of the upper lateral cartilages also preserves the dorsal aesthetic lines, permitting any necessary narrowing or straightening of the lines. After the skin envelope is redraped, the three-point dorsal palpation test is performed to ensure that a straight and smooth dorsum has been obtained before septal reconstruction or lateral osteotomies are begun.

Use of the three-point dorsal palpation test after each maneuver will help to ensure the creation of a smooth, straight dorsum.

It is important to make certain that the upper lateral cartilages are pulled in a dorsal direction to their correct position, because they have a tendency to fall away from the dorsum, giving the false impression that they have been appropriately aligned relative to the dorsal septum and bony vault when in fact they are still excessive.

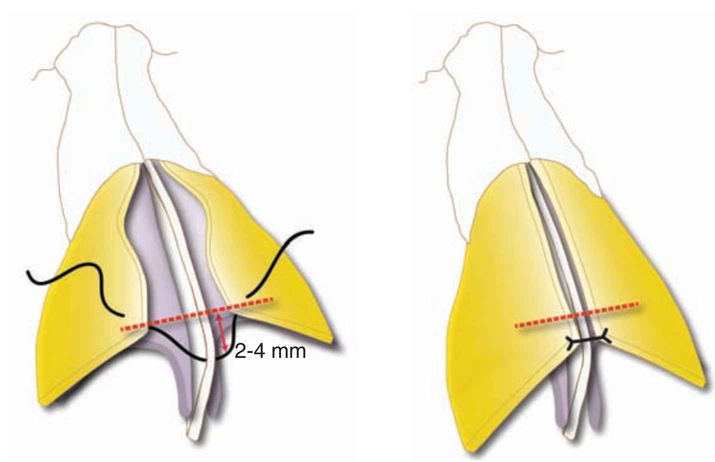
It is important to make certain that the upper lateral cartilages are pulled in a dorsal direction to their correct position, because they have a tendency to fall away from the dorsum giving the false impression that they have been appropriately aligned relative to the dorsal septum and bony vault when in fact they are still excessive.

7. Reconstitution of the Dorsum

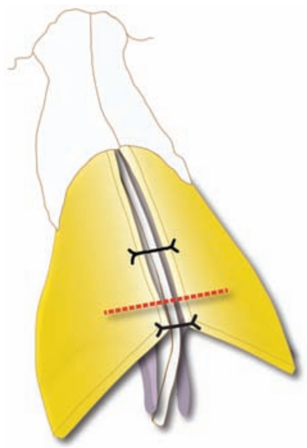
When they have been appropriately preserved, the dorsal edges of the upper lateral cartilages act as "autospreaders," maintaining the T-shaped contour of the dorsum that is critical for balanced dorsal aesthetic lines and preservation of the internal valves.

In addition to preservation of the upper lateral cartilages, proper reconstitution of the upper lateral cartilages with sutures (most common), spreader flaps, and/or spreader grafts (if indicated) is also essential.[4,5] We typically employ three types of dorsal reconstitution techniques that rely solely on appropriate suture placement. This approach has largely obviated the need for spreader grafts.

Type 1: Midvault Restoration Using the Upper Lateral Cartilage Tension-Spanning Suture



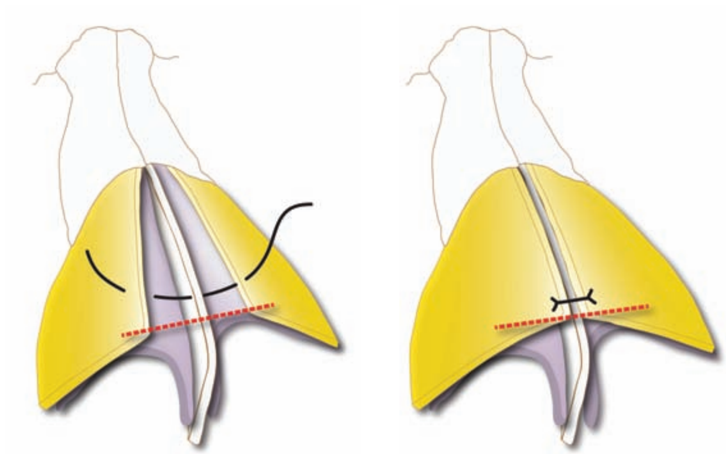
A 5-0 PDS suture is placed from the dorsal edges of both upper lateral cartilages to the distal septum, advancing both upper lateral cartilages 3 mm distally along the septum.



A second suture can be placed proximally along the upper lateral cartilages and septum as needed to give extra support and improve contour at any points of irregularity or bulging if a symmetrical upper lateral cartilage position was not achieved with placement of the previous suture.

The upper lateral tension-spanning suture stabilizes the upper lateral cartilages to the septum on slight tension, thereby providing a straighter and more anatomic contour. Use of the upper lateral tension-spanning suture is particularly beneficial in thin-skinned patients because of increased visibility of contour irregularities, and in patients requiring larger (3 mm or greater) dorsal hump reduction in which the differential between the septum and upper lateral cartilages is more pronounced, leading to a greater propensity for midvault irregularity.

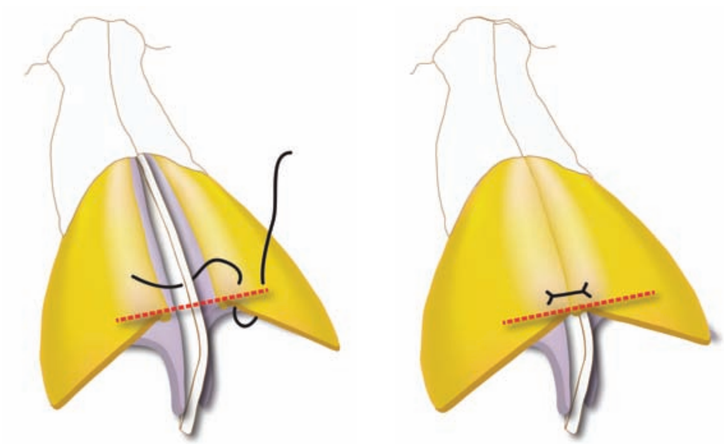
Type 2: Midvault Restoration Without Using the Upper Lateral Cartilage Tension-Spanning Suture



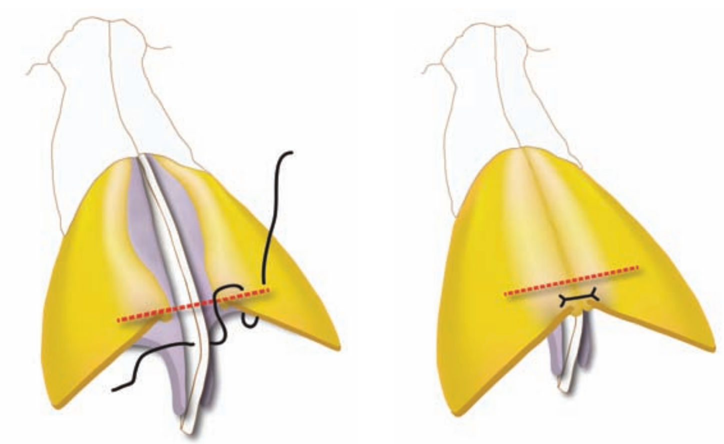
The 5-0 PDS suture is placed without advancing the edge of both upper lateral cartilages distally along the dorsal septum. This is indicated in patients with upper lateral cartilages that can maintain a straight contour after release from the septum. This is often the case for patients with strong cartilage who require minimal dorsal hump reduction. This is also indicated in patients where narrowing at the distal end of the midvault must be avoided. The upper lateral tension-

spanning suture often re-creates and enhances the natural taper seen with the upper lateral cartilages as they reach the supratip region in their distalmost dorsal attachment. By not placing the upper lateral cartilages on tension when reapproximating them to the septum, the surgeon is able to diminish the narrowing effect of this suture.

Type 3: Midvault Restoration With Spreader Flap Modification



Type 3A



Type 3B

The 5-0 PDS sutures are placed caudal to the upper edge of the upper lateral cartilages, thereby infolding the superior edge of the upper lateral cartilages. This serves a spreader-type function. This technique should be employed when attempting to widen the midvault. It can be used with (see type 3A, *above*) or without (see type 3B, *below*) advancement of the upper lateral cartilages along the dorsal septum acting as an upper lateral cartilage tension-spanning suture. The decision to perform the spreader flap with an upper lateral cartilage tension-spanning suture is based on the particular anatomic goals for the patient as described earlier with the type 1 and 2 techniques.

Reconstitution of the upper lateral cartilages following component reduction with sutures, such as the upper lateral cartilage tension-spanning suture, is an important component to achieving smooth and symmetric dorsal aesthetic lines.

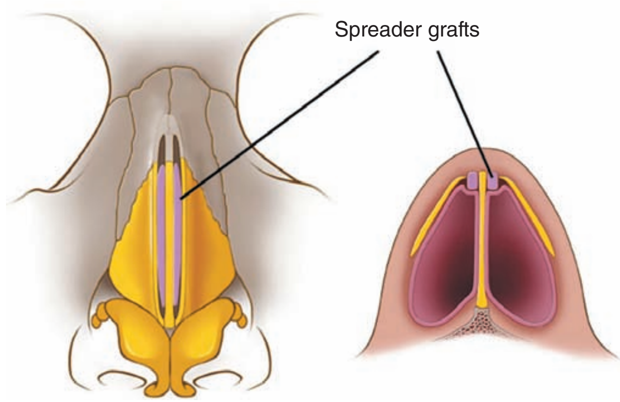
Since the introduction of spreader grafts in 1984, surgeons have used them extensively in both primary and secondary rhinoplasty.[2,15,16] Many rhinoplasty surgeons have embraced the concept, leading several authors to describe variants of the spreader graft and/or spreader flaps with different indications.[17-20] However, the enthusiasm behind spreader grafts and/or flaps may have extended their application beyond their utility, resulting in their application when not indicated.

Patients undergoing primary rhinoplasty with no existing nasal obstruction are unlikely to need spreader graft placement when the midvault is properly restored. Avoiding spreader graft placement may obviate the need for cartilage graft harvest and prevents dorsal widening when this is not desired. Use of the aforementioned approach for reconstituting the dorsum has proved reliable and reproducible while avoiding the use of spreader grafts in a majority of cases. Situations in which spreader graft and/or flap use is more likely to be required include secondary rhinoplasty midvault reconstruction, existing internal nasal valve dysfunction, and narrow nose syndrome in primary cases.

Criteria for Using Spreader Grafts and/or Flaps in Primary Rhinoplasty

1. Inverted-V deformity
2. Existing nasal obstruction secondary to internal valve insufficiency
3. Asymmetrical dorsal aesthetic lines despite the use of upper lateral tension-spanning sutures
4. Correction of dorsal septal deviation
5. Dorsal reduction greater than 5 mm
6. Ethnic nose with weak cartilaginous support
7. Males with a narrow nose

If spreader grafts are required, septal cartilage is harvested and the grafts are fashioned from the posterior inferior portion of the septal cartilage, which has the most consistent width (2 to 3 mm) and appropriate length (30 to 35 mm). The dimensions of the spreader grafts are typically 5 to 6 mm high and 30 to 32 mm long. Spreader grafts can be placed unilaterally or bilaterally, parallel to the septum, depending on the deformity being addressed.



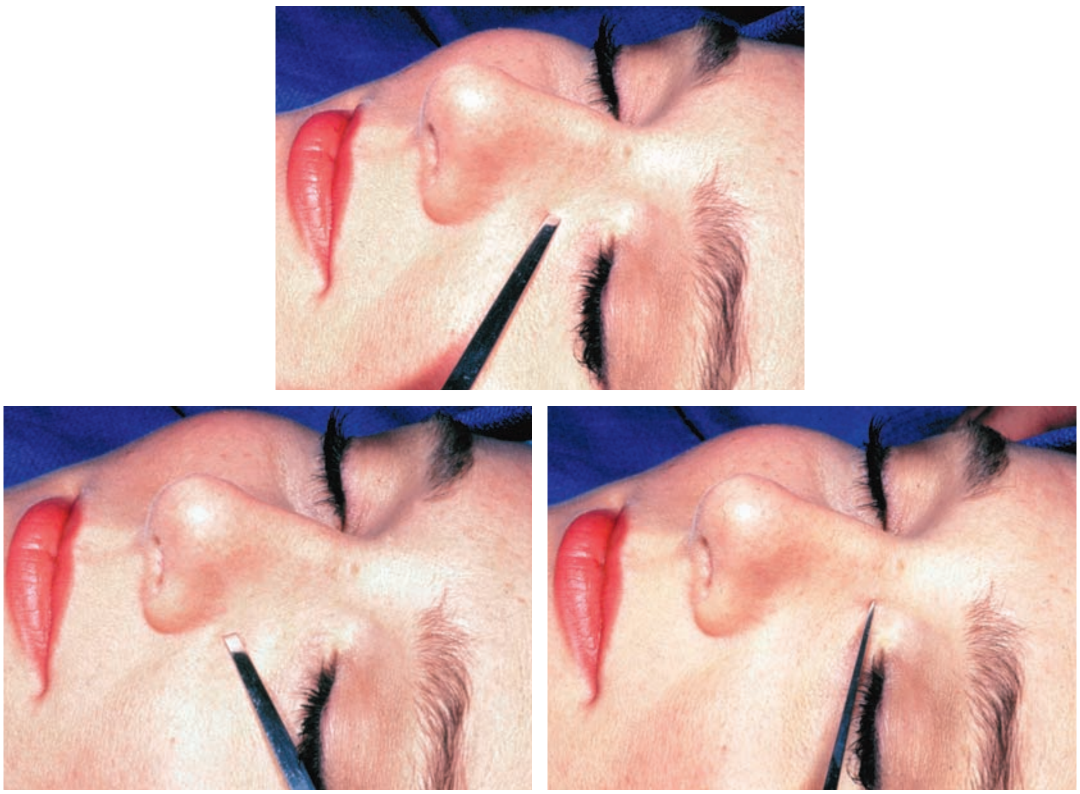
Spreader grafts may be positioned at or above the plane of the dorsal septum to be visible for aesthetic indications or below it as invisible grafts for purely functional indications.[6,14] Horizontal mattress sutures of 5-0 PDS are used to secure the grafts to the septum. The upper lateral cartilages are reattached to the spreader graft–septal complex. Resection of the upper lateral cartilages is not performed unless they produce a contour irregularity on clinical examination.

Preservation of the transverse portions of the upper lateral cartilages and proper reconstitution of the dorsum are necessary to maintain patency of the internal nasal valve and the shape of the dorsal aesthetic lines.

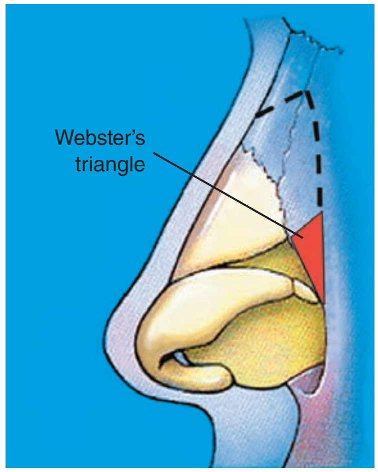
8. Medial/Lateral Osteotomies

Nasal osteotomies are used primarily to correct widened nasal bones, to reposition asymmetrical nasal bones, or to close an open-roof deformity, if present, after dorsal reduction.

The percutaneous perforated lateral nasal osteotomy technique[21,22] affords excellent control, stable long-term results, and shorter postoperative recovery time than internal nasal osteotomies do. Significantly decreased trauma to the nasal mucosa has been noted in cadaver studies using the percutaneous technique.[22]



Percutaneous perforated lateral nasal osteotomies are performed toward the end of the procedure at the same point in the surgical sequence as any other type of osteotomy.[6] We inject 1% lidocaine with epinephrine along the proposed osteotomy site at least 7 minutes before the osteotomy. A sharp 2 mm osteotome is used to perforate the skin along the nasofacial junction, parallel to the face of the maxilla at the level of the inferior orbital rim. Once introduced, the osteotome is tracked subperiosteally up onto the midportion of the nasal pyramid and then swept laterally down to the proposed site of the osteotomy along the nasofacial junction. This maneuver displaces the angular artery laterally away from the osteotomy path to prevent bleeding at the osteotomy site.[23]



The surgeon carefully directs the osteotome along the proposed osteotomy path while an assistant uses a mallet to create 2 mm osteotomies, skipping 2 mm each time from caudal at the piriform aperture to cephalad at the level of the medial canthi. Care is taken to preserve Webster's triangle to provide support for the internal nasal valve. We prefer to start with a low-to-low lateral osteotomy that continues into a superior oblique osteotomy at the level of the medial canthi; the junction of the osteotomies typically creates a 70-degree angle. The osteotome is tapped gently until a change in the sound and feel of the osteotome indicates complete perforation of the bone in each location.

This technique results in multiple 2 mm osteotomies with 2 mm of normal bone between each perforation. Once the perforated osteotomy has been completed along the entire course of the nasal bone, a similar procedure is performed on the contralateral side. Using gentle pressure applied with the thumb and forefinger, the surgeon then creates a greenstick fracture along each osteotomy site and positions the nasal bones in their desired location. After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure that no dorsal irregularities have been created. This is particularly important at the keystone area where the upper lateral cartilages can be pushed posteriorly deep to the nasal bones or become more prominent on the dorsum as a result of compression from the repositioned osteotomized segments of bone.

After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure that no dorsal irregularities have been created. This is particularly important at the keystone area.

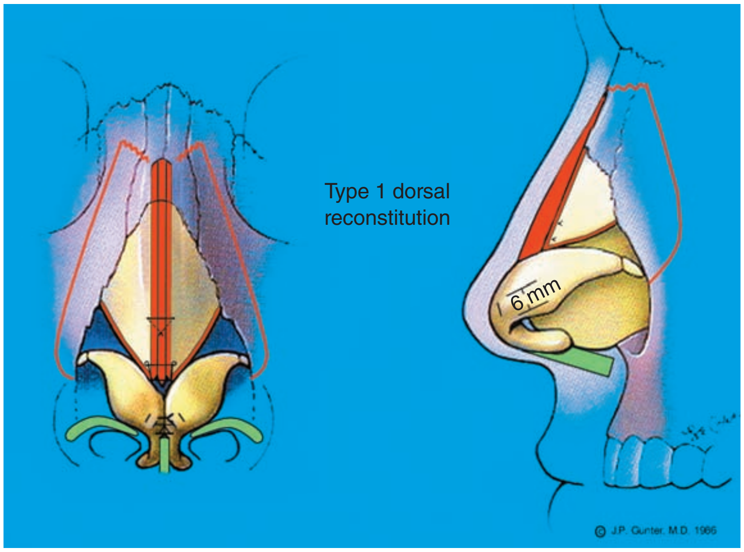
Closure of the two percutaneous osteotomy sites is not performed because bleeding is infrequent. Postoperatively, the osteotomy sites are covered by Steri-Strips after skin preparation. A flesh-colored metal splint is applied after it is contoured to fit the nasal dorsum. This splint is removed 7 days postoperatively. The percutaneous perforated lateral nasal osteotomy technique minimizes mucosal damage, postoperative intranasal bleeding, edema, and ecchymosis.

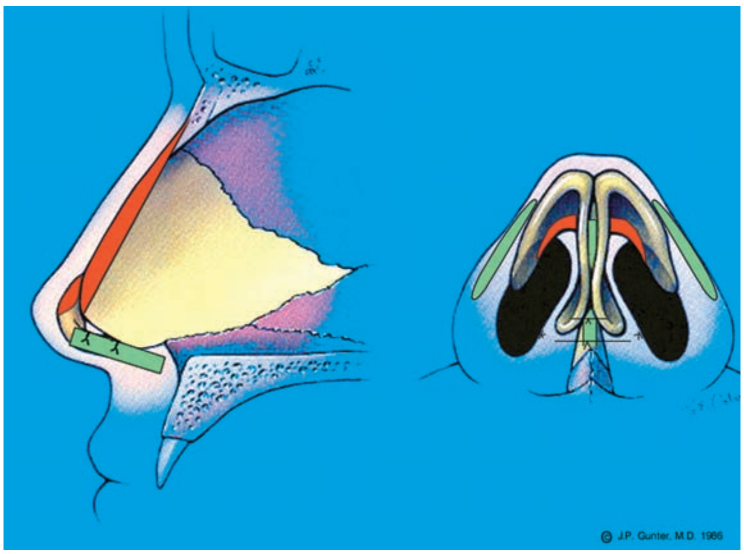
CASE ANALYSES

This healthy 24-year-old woman presented with a dorsal hump and bulbous tip. The frontal view demonstrates poorly defined dorsal aesthetic lines and a large, wide nasal tip. The lateral view demonstrates a moderate dorsal hump with supratip fullness and an underrotated tip.

The operative goals included the following:

- Reduce the dorsal hump.
- Create symmetrical and harmonious dorsal aesthetic lines.
- Increase tip rotation.
- Improve tip definition.





Surgical Plan

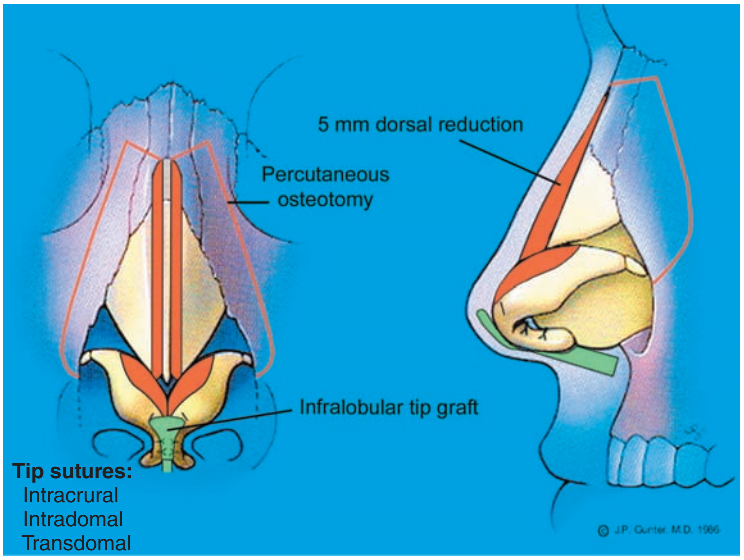
1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform component dorsal hump reduction (3 mm).
3. Perform septal reconstruction.
4. Reconstitute the dorsum with upper lateral cartilage tension-spanning suture (type 1).
5. Perform cephalic trim leaving a 6 mm alar rim strip.
6. Place a columellar strut.
7. Use intercrural, interdomal, and transdomal sutures (5-0 PDS).
8. Perform low-to-low percutaneous perforated lateral osteotomies.
9. Place alar contour grafts.

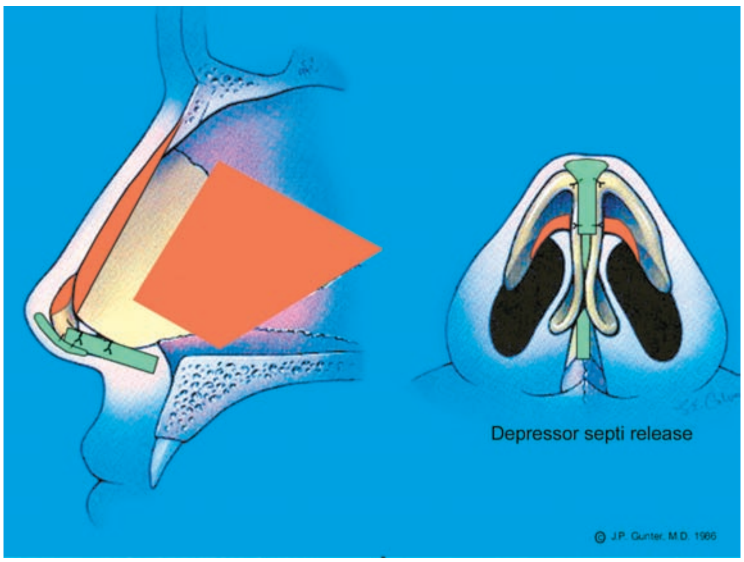
Comparison views of preoperative and 11-month appearance demonstrate correction of the dorsal hump with harmonious dorsal aesthetic lines, a supratip break, an increased nasolabial angle, and a well-defined tip.

This woman had a history of nasal airway obstruction, septal deviation, a dorsal hump, and an active depressor septi nasi muscle. The frontal view demonstrates obvious dorsal-to-caudal rightward septal deviation, with deviated dorsal aesthetic lines and tip-defining points and a slightly widened bony base.[6] She appeared to have an active depressor septi muscle on dynamic examination. The lateral view demonstrates a moderate dorsal hump and the appearance of an elongated nose because of the anterior radix position. Internal nasal examination revealed a septal tilt, with left dorsal septal deviation and right caudal septal deviation, as well as compensatory left inferior turbinate hypertrophy.

The operative goals included the following:

- Straighten the dorsum.
- Re-create symmetrical dorsal aesthetic lines.
- Correct/preserve the internal nasal valve.
- Reduce the dorsal hump.
- Increase tip projection to overcome the appearance of an elongated nose.
- Release active depressor septi nasi muscle.
- Correct inferior turbinate hypertrophy.





Surgical Plan[6]

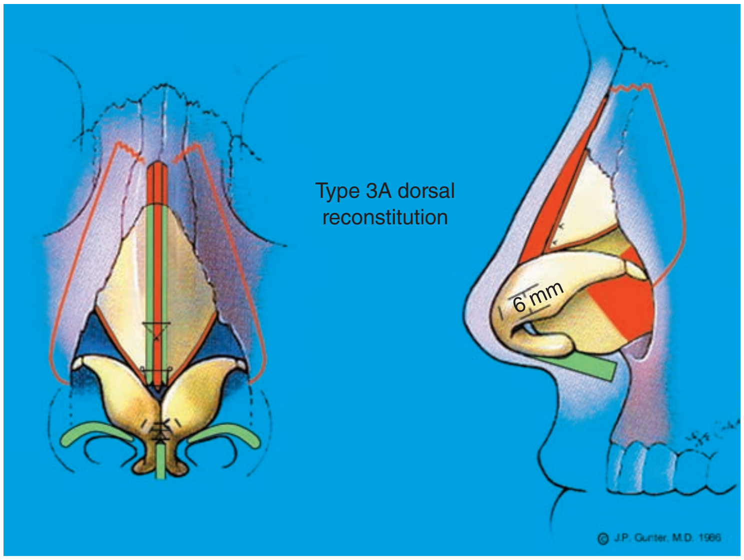
1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform component dorsal hump reduction (5 mm).
3. Harvest septal cartilage leaving an L-strut.
4. Reposition the caudal septum onto the anterior nasal spine.
5. Perform cephalic trim leaving a 6 mm alar rim strip.
6. Place a columellar strut.
7. Use intercrural, interdomal, and transdomal suturing.
8. Perform submucous resection and outfracturing of inferior turbinates.
9. Perform low-to-low percutaneous perforated lateral osteotomies.
10. Perform depressor septi nasi muscle release.
11. Place alar contour grafts.

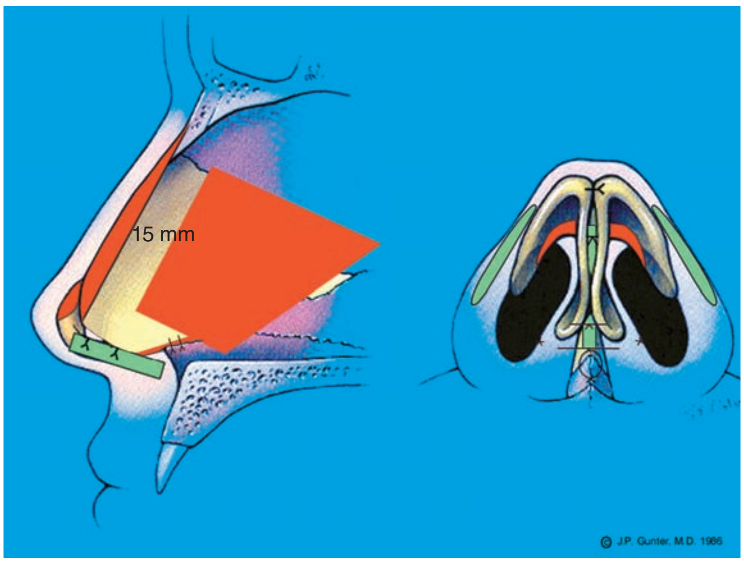
Comparison views of preoperative and 12-month postoperative appearance demonstrate correction of the deviation with redefinition of symmetrical dorsal aesthetic lines, correction of the dorsal hump, narrowing of the bony base, and refinement of the tip.[6] Of note, dynamic examination did not demonstrate a plunging tip, and the patient's subjective complaints of nasal airway obstruction resolved.

This 19-year-old woman desired aesthetic improvement of her nose. She also complained of nasal airway obstruction. On the frontal view, she has an ill-defined dorsal aesthetic line, a wide bony vault, and obscure tip-defining points. On the lateral view, she has a prominent dorsal hump and a subtle decrease in her nasolabial angle.

The operative goals included the following:

- Re-create symmetrical and harmonious dorsal aesthetic lines.
- Reduce the dorsal hump.
- Increase tip rotation slightly.
- Refine the tip and define tip-defining points.
- Narrow the bony base.





Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform component dorsal hump reduction (3 mm).
3. Perform septal reconstruction and cartilage harvest leaving an L-strut.
4. Reconstitute the dorsum with spreader flap modification with tension-spanning suture (type 3a).
5. Perform cephalic trim, leaving a 6 mm alar rim strip.
6. Place a columellar strut.
7. Use intercrural, interdomal, and transdomal sutures (5-0 PDS).
8. Perform low-to-low percutaneous perforated lateral osteotomies.
9. Place alar contour grafts.

Comparison views of the patient's preoperative and 2-month postoperative appearance demonstrates redefinition of symmetrical dorsal aesthetic lines, correction of the dorsal hump, narrowing of the bony base, and refinement of the tip.

KEY POINTS

- A graduated approach is critical, with preservation and proper reconstitution of upper lateral cartilages when reducing a dorsal hump.
- Preservation or creation of dorsal aesthetic lines with a smooth, symmetrical, continuous contour is critical in rhinoplasty.
- The radix is located between the supratarsal fold and the upper eyelid lashes, and its position affects the apparent length and projection of the nose on the lateral view.
- The width of the dorsum at the keystone area must be preserved. The width of the bony base should be equal to 75% to 80% of the intercanthal distance or normal alar base width.

- In women, the dorsum should lie just below a line connecting the nasofrontal angle with the tip-defining points, whereas the dorsum should be no lower than this line in men to avoid feminizing the nose.
- Preservation of the lateral soft tissue and periosteal attachments to the bony sidewalls provides significant support and stability for the nasal pyramid after osteotomies have been performed; therefore lateral dissection must be limited to the amount necessary to allow access for bony hump reduction.
- Creation of bilateral submucoperichondrial tunnels before component reduction of the dorsal hump prevents cicatricial narrowing of the internal nasal valve and webbing of the vestibule.
- Excessive resection of the dorsal edges of the upper lateral cartilages can lead to an inverted-V deformity or an overly narrow midvault.
- Reduction of the bony hump is most commonly carried out with a downbiting rasp; large humps may require a guarded osteotome or a power oscillating burr with a dorsal skin protector.
- Use of the three-point palpation test after each maneuver will help ensure the creation of a smooth, straight dorsum.
- It is important to make certain that the upper lateral cartilages are pulled in a dorsal direction to their correct position, because they have a tendency to fall away from the dorsum giving the false impression that they have been appropriately aligned relative to the dorsal septum and bony vault when in fact they are still excessive.
- Preservation of the transverse portions of the upper lateral cartilages and proper reconstitution of the dorsum are necessary to maintain patency of the internal nasal valve and the shape of the dorsal aesthetic lines.
- After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure that no dorsal irregularities have been created. This is particularly important at the keystone area.

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14

Nasal Osteotomies

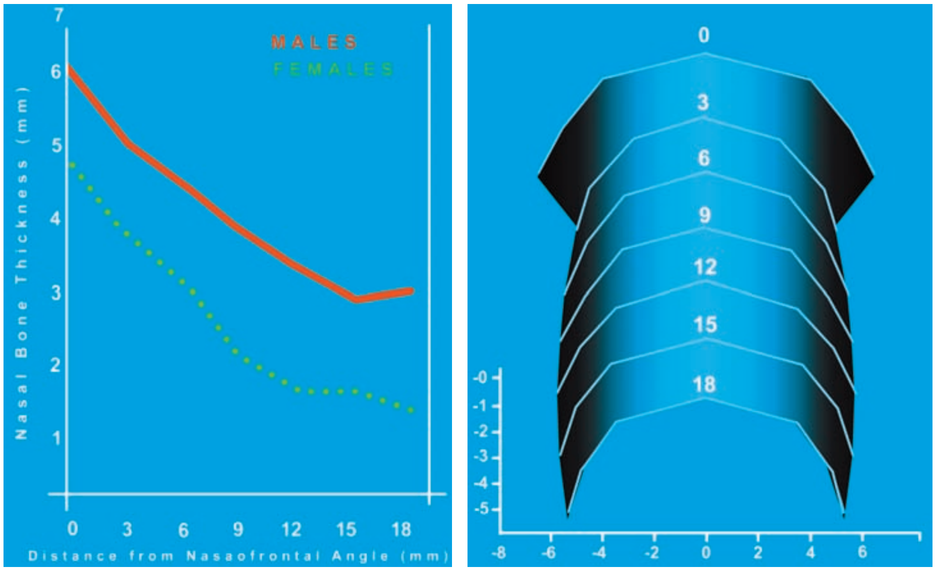
Rod J. Rohrich ▪ William P. Adams Jr. ▪ Jamil Ahmad

In rhinoplasty, osteotomies can be used to close an open roof deformity, straighten deviated nasal bones, or to narrow the bony nasal pyramid. Although various methods exist to perform osteotomies, including internal and percutaneous (external) techniques, no one definitive technique has proved to be superior to all others.[1-21] If an osteotomy is performed inadequately, however, a number of cosmetic, functional, and surgical complications can arise.[22-25,40]

ANATOMY

The bony nasal vault consists of the paired nasal bones and the ascending frontal process of the maxilla and constitutes the upper third of the nose. The nasal bones articulate with one another medially, the maxilla laterally, the frontal bones superiorly, and the perpendicular plate of the ethmoid posteriorly.

They average 2.5 cm long, and approximate an hourglass configuration. Nasal bones are widest at the nasofrontal suture line (14 mm), narrowest at the nasofrontal angle (10 mm), then widen to 12 mm approximately 9 to 12 mm inferior to the radix, after which they gently narrow toward the tip.[26,27] Dorsally, nasal bones are thickest at the nasofrontal suture line (5 to 7 mm) and thin progressively toward the tip. From this position, the bony vault acts as a cantilever that supports the upper nose and upper lateral cartilages.



The *keystone area* is the name given to the critical anatomic region where the cephalic portion of the upper lateral cartilages attaches to the undersurface of the distal nasal bones. The nasal bone overlaps the upper lateral cartilages nearly 9 mm in the midline, which decreases in the lateral direction.[28] This region is important in supporting the middle nasal vault and is at risk for excessive narrowing during osteotomy.

A complete understanding of nasal anatomy and its inherent variations is essential for optimizing outcomes of nasal osteotomies.

For optimal results, osteotomies should be designed to cut through intermediate or transition zones of bony thickness along the lateral nasal wall.[29] Such a zone exists along the ascending frontal processes of the maxilla from the piriform aperture to the radix. Anatomic studies have demonstrated that this region of the nasal wall is less than 2.5 mm thick and can be reliably osteotomized with small osteotomes, producing predictable fracture patterns.[9,26]

A transition zone of bony thickness exists along the frontal processes of the maxilla near the junction with the nasal bones. This area of relatively thin bone is easily and consistently mobilized during lateral nasal osteotomies.

CONTRAINDICATIONS

Osteotomies may be contraindicated in elderly patients with thin, fragile nasal bones, patients who wear heavy eyeglasses, patients with congenitally short nasal bones (where the caudal border is less than 1 cm below the intercanthal line), or patients with thick nasal skin and/or a history of hypertrophic scar formation.[30,31] Patients of certain nonwhite races with extremely low, broad noses should be approached with extreme caution, because osteotomies can be difficult in this patient subpopulation.[32]

CLASSIFICATION

Osteotomies may be classified according to the type (lateral, medial, transverse, or a combination of these types), level (low-to-high, low-to-low, and double), and approach (internal or percutaneous). Selecting the appropriate technique will depend on specific aspects of the patient's anatomy, type of deformity, desired outcome and the cosmetic and functional affects the changes will have on the nose.

Type

Lateral Osteotomies

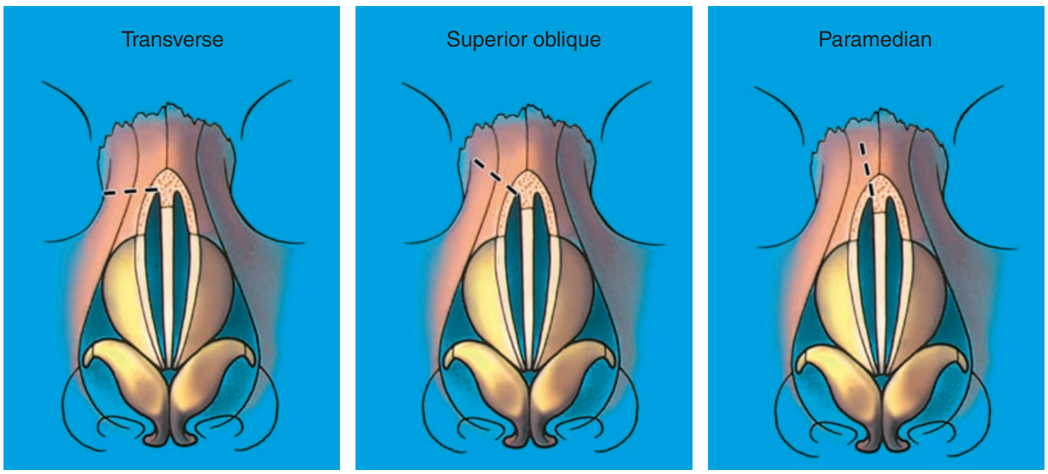
The purpose of lateral nasal osteotomy is to narrow a widened lateral nasal wall, close an open roof deformity, and mobilize a deviated nasal pyramid. This procedure traditionally consists of cutting or perforating the most lateral aspect of the bony pyramid along the transition zone of thinner bone, followed by medial, transverse, or digital greenstick fracturing of the lateral and/or superior bony attachments. This maneuver produces enough mobilization to permit narrowing or repositioning of the nasal bones.

The purpose of lateral nasal osteotomy is to narrow a widened lateral nasal wall, close an open roof deformity, and mobilize a deviated nasal pyramid.

Lateral osteotomies can be used to alter the width of the bony vault at the nose-cheek junction, the width of the superior aspect of the dorsal aesthetic lines, or to change the angle of inclination of the bony nasal sidewalls.

Medial Osteotomies

A medial osteotomy is defined as a separation of the nasal bones and the bony septum. Numerous orientations have been proposed in the literature, including paramedian, medial oblique, superior oblique, transverse, and inferiorly oriented, as well as adjuncts such as a high septal osteotomy. A wedge of medial nasal bone may be excised with a paramedian osteotomy to allow further medialization of the nasal bones. In any case, the most cephalic extent should not course superior to the intercanthal line.

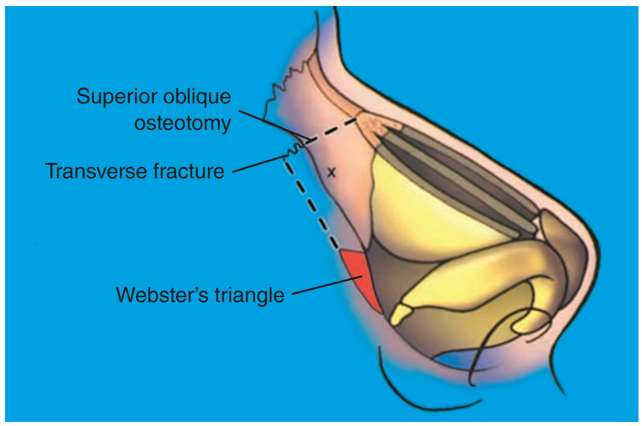


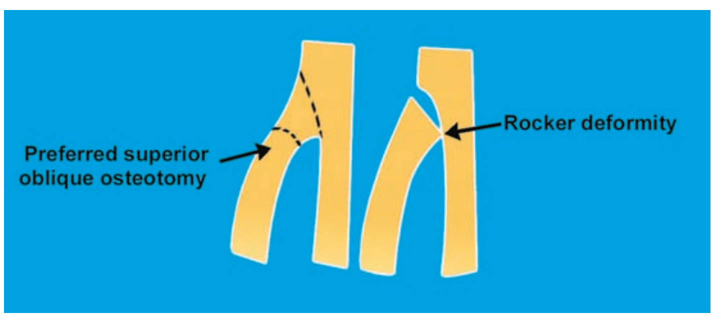
Medial osteotomies may be performed when the bony dorsum is excessively wide, the nasal bones are deviated, or the bony dorsum is excessively narrow and needs to be widened with spreader grafts. Medial osteotomies are generally used in patients with thick nasal bones or a wide bony base, as greenstick fractures within these subgroups tend to be difficult and can lead to unpredictable fracture patterns. The basic objective is to produce medial shift of the nasal bones in a controlled manner, thus avoiding undesirably large greenstick fractures that tend to increase the risk of airway narrowing and bony collapse. Medial, transverse, or greenstick fractures of the upper bony segment can be combined with lateral osteotomies, depending on the effect desired. They are usually performed after dorsal hump resection and before lateral osteotomy, allowing for a stable bony vault to work with. In many cases, dorsal hump reduction will mimic medial osteotomies and obviate their need.

Medial osteotomies may be performed when the bony dorsum is excessively wide, the nasal bones are deviated, or the bony dorsum is excessively narrow and needs to be widened with spreader grafts.

Despite previous descriptions, it remains difficult to perform medial osteotomies in such a way as to provide aesthetically pleasing and reliable results. The nasal bony vault varies in thickness regionally, making controlled narrowing with osteotomies challenging.

The nasal bony vault varies in thickness regionally, making controlled narrowing challenging; thus aesthetically pleasing and reliable results remain difficult to obtain with medial osteotomies.

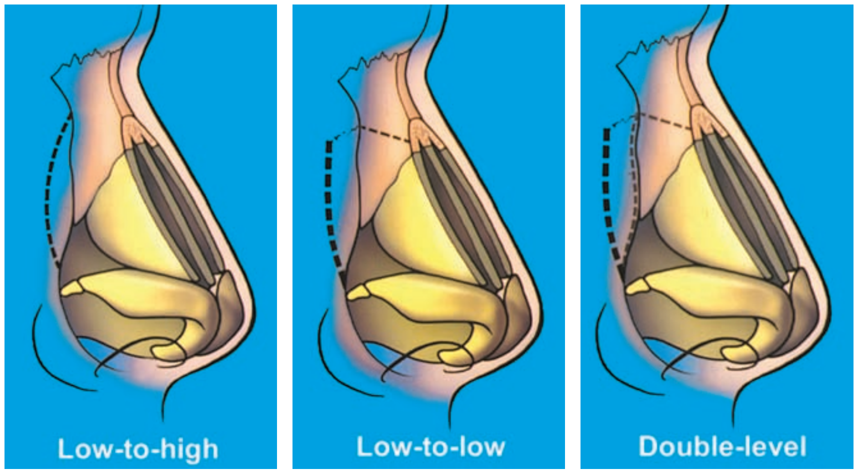




It is critical to avoid a "rocker deformity," whereby the upper portion of the fractured nasal bone "kicks out," resulting in a widened upper dorsum. This can be avoided by canting the medial osteotomy in a medial oblique direction.

Level

Lateral osteotomies can be described based on their position along the bony vault and proximity to the nasal dorsum or maxilla. Lateral osteotomies made closer to the maxilla are referred to as *low* and those made closer to the dorsum are referred to as *high.*



Low-to-High

The low-to-high osteotomy begins low at the piriform aperture, extends cephalad toward the intercanthal line, and ends high on the nasal dorsum. The nasal bones are subsequently medialized via a greenstick fracture, which follows predictable fracture patterns based on nasal bone thickness. This type of osteotomy is generally used to mobilize a moderately wide nasal base or to correct a small open roof deformity. This type of osteotomy is much less frequently performed compared with a low-to-low technique.

Low-to-Low

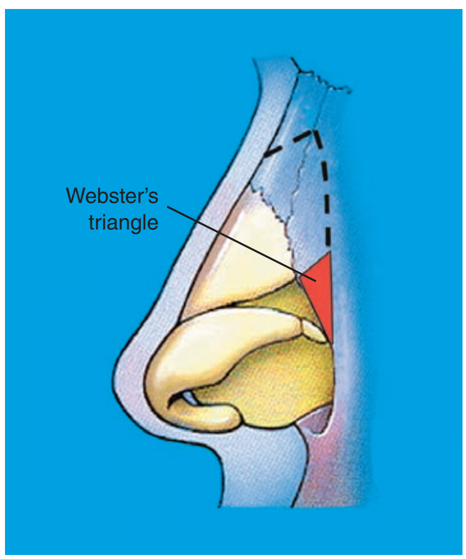
Low-to-low osteotomies result in more medial movement of the nasal bones and are therefore considered to be a more powerful technique. They are classically used to correct a large open roof deformity or to narrow an excessively wide nasal base. This osteotomy starts low along the piriform aperture and remains low along the base of the bony vault ending at a location near the intercanthal line. Frequently, a medial osteotomy is performed in conjunction with a low-to-low osteotomy to better mobilize the nasal bones, as there is a greater amount of bone present between the midline and the lateral osteotomy line.

Double-Level Osteotomies

A double-level osteotomy is typically used when there is excessive lateral wall convexity. This procedure essentially combines a low-to-low osteotomy with a parallel, but more medially located, lateral osteotomy, which approximates the nasal maxillary suture. This parallel osteotomy should be performed first so as to preserve stable bone on which to perform the low-to-low osteotomy.[30]

At the top of the lateral osteotomy it is common to have a few millimeters of unfractured bone. In patients with normal bony thickness, digital pressure may be applied to produce a transverse greenstick fracture in the medial segment. This maneuver will produce the desired narrowing by tilting the bones medially. In patients with thicker nasal bones, increased risk of airway compromise, and risk of bone collapse, a superior oblique osteotomy is performed to complete the osteotomy or to narrow the gap enough so that digital pressure can complete mobilization of the bones.

Regardless of how the osteotomies are performed, however, preservation of Webster's triangle, a triangular area of the caudal aspect of the frontal process of the maxilla abutting the piriform aperture, is mandatory to prevent collapse of the internal nasal valve with subsequent nasal airway obstruction.



Furthermore, step-off deformities are prevented by staying low along the bony vault, keeping the most cephalic margin of the osteotomy below the intercanthal line/medial canthal ligament. Complications, such as iatrogenic lacrimal system disruption with resultant epiphora, are likely if osteotomies are continued more cephalad to this boundary into the thicker nasal bones.[23]

Approach

Although the literature describes various methods of performing nasal osteotomies, the optimal surgical technique remains controversial.[1,6-14,16-20,33] Access to the bony pyramid using alar, buccal,[32,34] vestibular, or external incisions have been described. Various instruments including osteotomes, cutting forceps, saws,[35] and electrical instruments have been used to perform osteotomies.[10,36] Currently two different techniques are most frequently used for lateral osteotomies: the internal continuous lateral osteotomy and the percutaneous (external) perforated (discontinuous) lateral osteotomy. They should be executed with care and control to preserve as much soft tissue and as many periosteal attachments as possible, avoiding large subperiosteal tunnels and any unnecessary undermining. Additionally, 2 to 3 mm osteotomes are frequently used to minimize bleeding, soft tissue disruption, and scarring.[6,15,37,38]

The two most frequently used techniques are the internal continuous lateral osteotomy and the percutaneous perforated lateral osteotomy, both of which should be executed with care and control, preserving soft tissue and periosteal attachments, and avoiding large subperiosteal tunnels and unnecessary undermining.

Internal Continuous Lateral Osteotomy

Internal continuous lateral osteotomies are most frequently performed through the vestibular approach.

Operative Technique An opening is made through the vestibular skin anterior to the end of the inferior turbinate using Iris scissors. The scissors are inserted down to the periosteum lateral to the piriform aperture rim, and spread just enough to accommodate a curved or straight osteotome with a small guard on the lateral edge.

The edge of the piriform aperture is felt using the blade of the osteotome. By pressing the guard against the lateral surface and palpating it with the index finger of the free hand, the blade is moved to the desired starting position on the rim. This position is usually at the level of the attachment of the anterior end of the inferior turbinate. It is slightly more anterosuperior than the most posterior point of the piriform aperture edge to preserve Webster's triangle, which is a triangular area of intact maxillary frontal process near the internal valve region. Theoretically, if the osteotomy is started low (at the most posterior point of the piriform aperture), infracture could move the anterior end of the inferior turbinate medially and compromise the airway at the level of the internal nasal valve.

Therefore the osteotomy is started more superiorly on the rim and is angled slightly toward the maxilla. This position allows the osteotome to get to the nasal cheek junction, where it continues superiorly along the base of the bony vault and curves toward the nasal root. It stops at the level of the medial canthus, where it should be a few millimeters from the lateral end of the medial osteotomy. The osteotomy does not separate the nasal-maxillary suture unless a double osteotomy is performed. Rather, the osteotomy should course toward the point of maximal width, as determined on examination.[39] If a medial osteotomy was not performed, the infracture is accomplished by rotating the guard of the osteotome toward the dorsum while gently moving the free end of the osteotome medially. This will result in a greenstick fracture from the superior end of the osteotomy site through the weakest line of the nasal bone. If a medial osteotomy was performed, gentle digital pressure is generally sufficient to infracture the segment. Under ordinary circumstances a greenstick fracture is preferred, because a complete fracture is unstable and more difficult to control.

Percutaneous Perforated Lateral Osteotomy

Percutaneous perforated lateral osteotomies are our preferred technique; they have proved to be predictable and reliable in the correction of the aforementioned deformities. This procedure involves discontinuous perforations made by a sharp osteotome along the lateral aspect of the bony pyramid, followed by greenstick infracturing performed using digital manipulation. It is associated with minimal morbidity and can be executed at any time during the rhinoplasty operative sequence.

Operative Technique Percutaneous perforated lateral nasal osteotomies confer specific advantages based on the preservation of soft tissue attachments along with the periosteum, including:

- Greater stability after repositioning
- Decreased dead space
- Reduced bony malposition with resultant overnarrowing of the bony vault and/or airway compromise
- Prevention of flail segment of fractured bone

We generally perform lateral osteotomies during the final stages of the operation, after the dorsal-nasal height, septum, and tip have been addressed, although technically they can be performed at any time during the operative sequence. Uncommonly, osteotomies can increase intraoperative edema and ecchymosis obscuring visual evaluation and making further refinements more challenging to perform. It is important to note that when performing the initial exposure during rhinoplasty, undermining over the bony vault should be limited to the central dorsum to preserve soft tissue attachments to the nasal bones laterally.

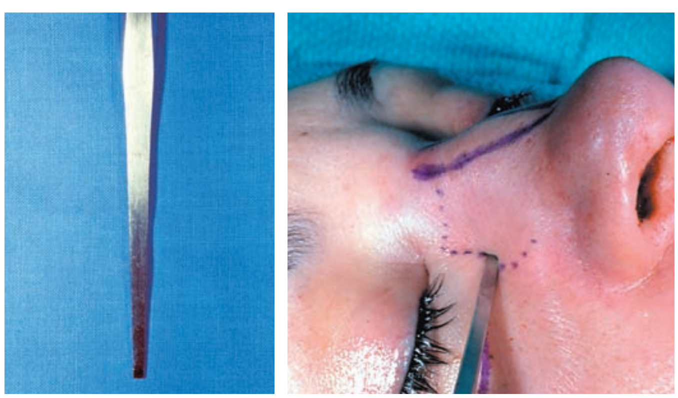
When performing the initial exposure during rhinoplasty, undermining over the bony vault should be limited to the central dorsum to preserve soft tissue attachments to the nasal bones laterally.

Our preferred technique is as follows[1,14]:

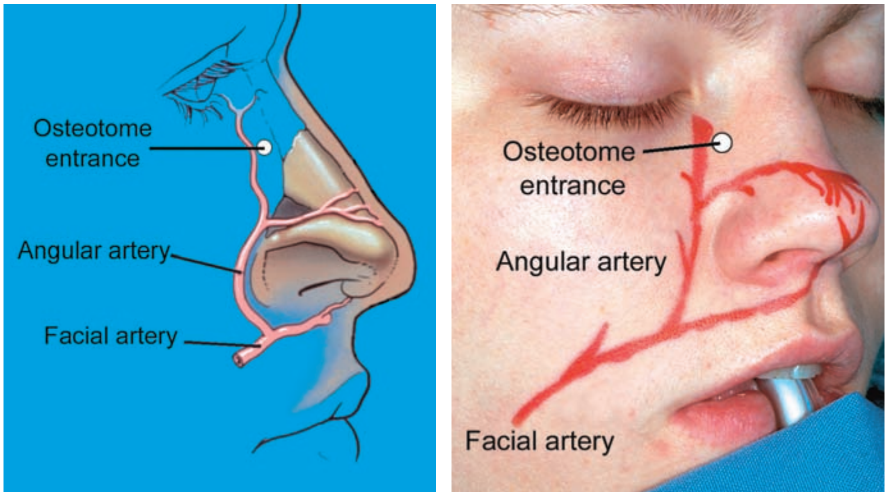
1. Inject approximately 2 ml of 1% lidocaine with 1:100,000 epinephrine, both intranasally and along the lateral nasal sidewalls. Allow approximately 7 minutes for the hemostatic effect of the epinephrine to take place.
2. Sharpen a flat 2 mm osteotome, rinse with saline solution, wipe with a clean towel, and rinse again to remove all dust from the surgical whetstone.[38]

Contraindications include elderly patients with thin, fragile nasal bones, patients who wear heavy eyeglasses, patients with congenitally short nasal bones (where the caudal border is less than one centimeter below the intercanthal line), or patients with thick nasal skin and/or a history of hypertrophic scar formation. Caution should also be exercised in certain nonwhite races with low, broad noses.

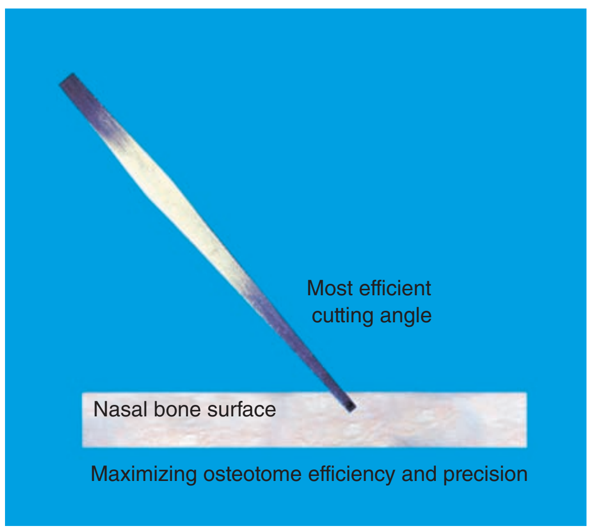
Always use a sharp osteotome (2 mm preferred). Visible scarring can be reduced by cleansing the osteotome before use.



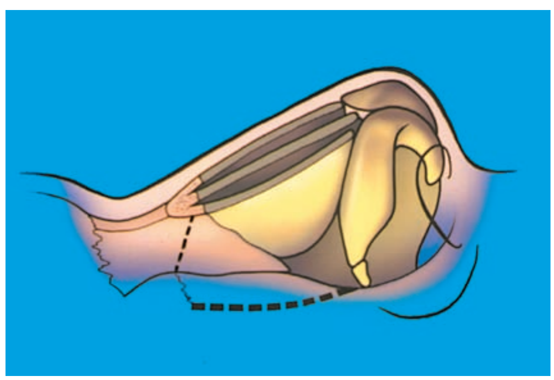
3. Introduce the sharpened 2 mm osteotome percutaneously at the midportion of the bony nasal pyramid at the level of the inferior orbital rim and nasofacial junction parallel to the horizontal surface of the maxilla.



4. Avoid injury to the angular artery by sweeping the osteotome down the lateral nasal sidewall in the subperiosteal plane to the halfway point of the proposed pathway of the osteotomy.



5. Orient the osteotome at an angle so that only one corner of the edge is in direct contact with the bone to precisely focus the force and minimize trauma. Strike with the mallet until a change in both feel and sound at that location is achieved.



6. Perform multiple discontinuous osteotomies spaced 2 mm apart in the configuration desired (low-to-low, low-to-high, or other).

It is imperative to remain within the initial percutaneous puncture site while extending the osteotomies to prevent increased risk of iatrogenic angular artery trauma and subsequent ecchymosis.

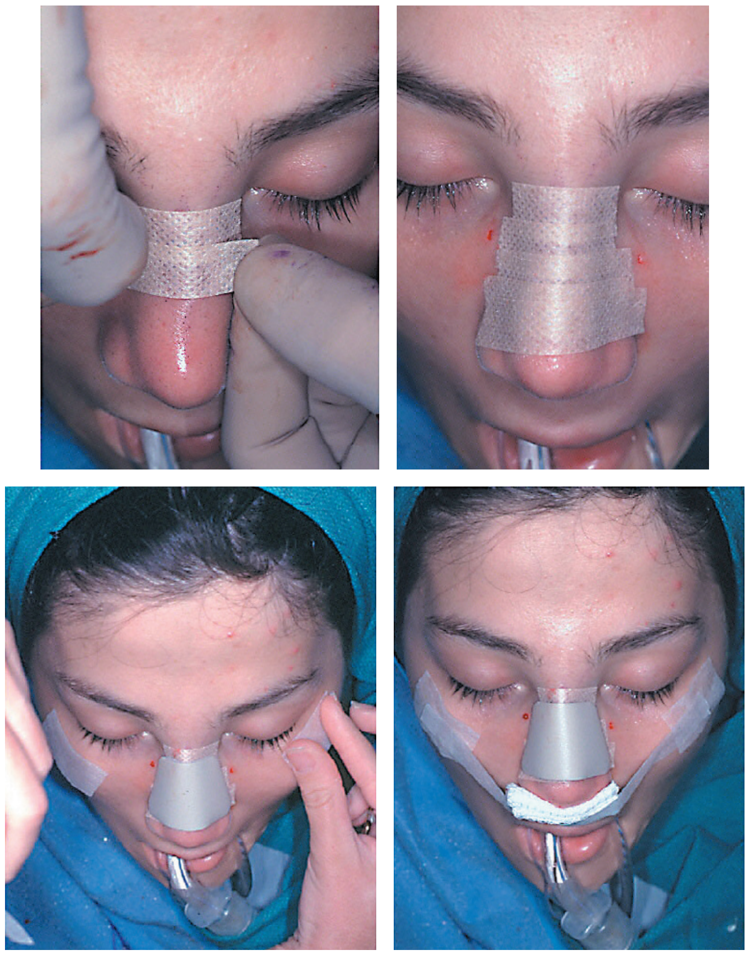
If it is necessary to withdraw the osteotome, it should be replaced in the original percutaneous access site with the same precautionary downward sweeping motion, as previously described. Perform the same procedure on the contralateral side.

7. After the bilateral osteotomies are completed, perform a greenstick fracture of the nasal bones using gentle pressure between the thumb and forefinger until they are positioned in their desired location. If more than gentle digital pressure is required, reinsert the osteotome and evaluate the prior osteotomy line for persistent large gaps between perforations.

After the perforated osteotomies are completed, a controlled, bimanual greenstick fracture is made to allow repositioning of the bony pyramid. Osteotomies can be performed at any point during the procedure. After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure no dorsal irregularities have been created. This is particularly important at the keystone area.

8. After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure no dorsal irregularities have been created. This is particularly important at the keystone area where the upper lateral cartilages can be pushed posteriorly deep to the nasal bones or become more prominent on the dorsum due to compression from the repositioned osteotomized segments of bone.

After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure no dorsal irregularities have been created. This is particularly important at the keystone area.



9. No sutures are required to maintain position of the osteotomized segments. It is helpful to apply gentle sustained pressure to the osteotomy sites to decrease bleeding and to help prevent postoperative ecchymosis. The nasal skin is cleansed with alcohol and adhesive is applied followed by Steri-Strips. A malleable dorsal compression splint (Denver splint) is contoured and applied to the nasal dorsum for 7 days to minimize postoperative edema.

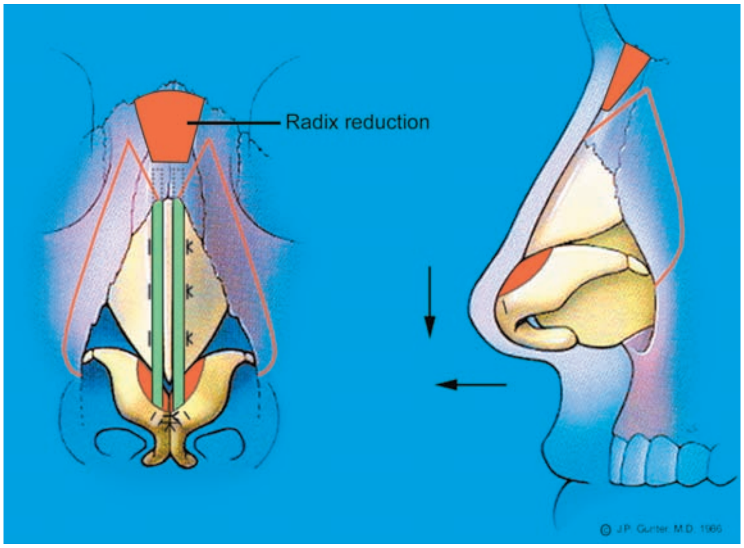
The surgeon must avoid overcompression during application of the Denver splint to prevent malposition of the osteomized segments resulting in overnarrowing of the bony vault. Care should be taken to avoid iatrogenic injury to the angular artery by sweeping down the lateral nasal sidewall in a subperiosteal plane.

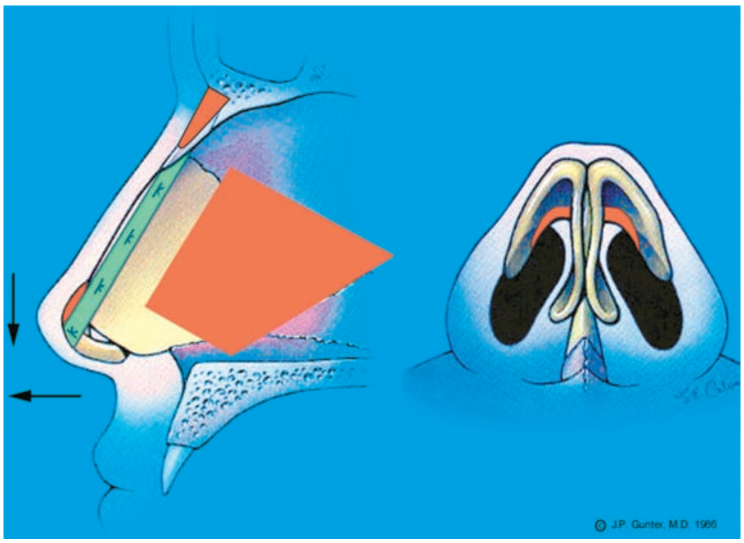
CASE ANALYSES

This 19-year-old woman expressed dissatisfaction with the appearance of her nose and complained of nasal airway obstruction. She was otherwise healthy and had no past medical or surgical history and no history of facial trauma. Clinical analysis revealed a good facial profile and facial proportions, moderately thick nasal skin, wide dorsal aesthetic lines with a broad nasal base, a bulbous nasal tip, a high radix with short nose, and inadequate tip projection.

The operative goals included the following:

- Lengthen the nose.
- Increase tip projection.
- Narrow dorsal aesthetic lines.
- Refine and correct the bulbous nasal tip.





Surgical Plan

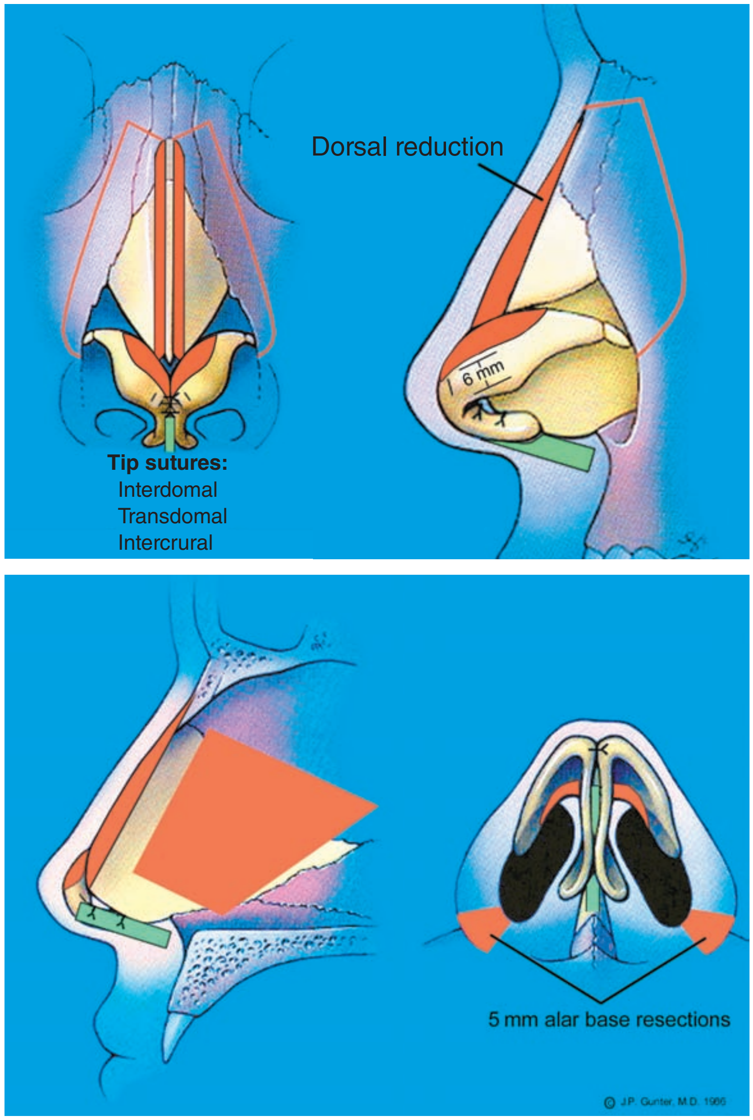
1. Use an open approach with a transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Lower the radix using a burr.
3. Correct the slightly deviated nasal septum and harvest septal cartilage, leaving an L-strut.
4. Use bilateral extended spreader grafts to lengthen the nose.
5. Perform wide undermining of the nasal tip skin and release the lower lateral cartilages from their attachments to the upper lateral cartilages.
6. Perform cephalic trim leaving a 6 mm alar rim strip.
7. Use interdomal and transdomal suturing to refine the tip.
8. Perform percutaneous perforated lateral low-to-low and superior oblique osteotomies.

The patient is shown 5 years after surgery. Clinical analysis at this time revealed a normal radix, narrowed dorsal aesthetic lines, improved nasofacial balance, increased tip projection, increased nasal length, and a refined nasal tip.

This 58-year-old woman desired aesthetic correction to her nose and did not complain of nasal airway obstruction. She had a past medical history significant for basal cell cancer of the dorsum of her nose and had undergone Mohs micrographic surgery with subsequent skin graft reconstruction at an outside facility. On the frontal view, a wide bony base, poorly defined tip, and nostril asymmetry were noted. On the lateral view, a dorsal hump was easily discerned, with a stepoff near the radix.

The operative goals included the following:

- Straighten the dorsum.
- Re-create symmetrical dorsal aesthetic lines.
- Narrow the bony base.
- Reduce dorsal hump.
- Refine tip.
- Correct nostril asymmetry.



Surgical Plan

1. Use an open approach with transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Perform component reduction of the dorsum (3 mm).
3. Harvest septal cartilage, leaving an L-strut.
4. Perform cephalic trim, leaving a 6 mm alar rim strip.
5. Place a columellar strut with medial crural strut sutures to unify the tip complex.
6. Perform intercrural, interdomal, and transdomal suturing to refine the tip.
7. Perform percutaneous perforated lateral low-to-low and superior oblique osteotomies.
8. Resect the alar base.

The patient is seen 9 months postoperatively showing narrowing of her dorsum, correction of the dorsal hump, refinement of the tip, and improvement of nostril symmetry.

POSTOPERATIVE CARE

Although postoperative care is individualized, we recommend head-of-bed elevation, perioperative antibiotic therapy (cephalexin 500 mg by mouth every 8 hours for 24 hours), a steroid dose-pack (Medrol), activity restriction, and narcotic pain control (hydrocodone/acetaminophen).

We strongly encourage the use of nasal saline solution, and in some cases, a nasal decongestant such as oxymetolazone nasal spray for postoperative nasal congestion and ask patients to avoid nose blowing, straining, or performing heavy or strenuous activity for 3 weeks. We also caution against eating any foods that require excessive lip movements or transmission of compression through the nasomaxillary buttress (such as apples and corn on the cob).

Patient management is individualized and depends on the extent of functional or aesthetic refinement; however, perioperative antibiotics, a steroid dose-pack, and activity restriction are important considerations.

Cool compresses are applied periorbitally for the first 48 hours. The patient should not allow anything to rest on the nose for at least 4 weeks, including eyeglasses. After this time, the patient should only resume wearing glasses if there is no discomfort felt along the bony vault. If needed, glasses can be taped to the forehead, or contact lenses can be worn as soon as the edema has diminished sufficiently to allow easy insertion.

Osteotomy can be the most traumatic and least controlled with the potential for a variety of serious complications. The surgeon should therefore develop and feel comfortable with a technique offering reproducibility, consistency, and minimal morbidity.

COMPLICATIONS

Complications of Lateral Nasal Osteotomies

Infections	Operative Trauma	Cosmetic Problems
Local Abscess Cellulitis Granuloma	Hemorrhage (hematoma, ecchymosis)	Excessive narrowing or convexity
Systemic	Edema	Insufficient mobilization of lateral bony walls
Intracranial	Nasal cyst formation Anosmia Arteriovenous fistula Epiphora Canalicular bleeding Neuromuscular injury Intracranial injury	Unstable bony pyramid Rocker formation Redundant soft tissue Stair-step deformity Nasal bone asymmetry

Complications may arise, regardless of the technique used. Familiarity with the diagnosis and treatment of these is critical to the complete care of the patient.

The percutaneous perforated lateral osteotomy technique using a sharp 2 mm osteotome provides excellent control of the bony pyramid and is associated with a reduction in intranasal trauma.

CONCLUSION

Osteotomies are an extremely useful technique that can be performed in both cosmetic and functional nasal surgery. They are generally used to narrow the lateral nasal walls, to close open roof deformities, and to create symmetry by allowing for straightening of the nasal bony pyramid. Although they can be performed in a variety of ways, the rhinoplasty surgeon must understand the indications, advantages, disadvantages, and potential complications of each approach. We have found the percutaneous perforated lateral osteotomy technique to be reliable, reproducible, and predictable. If performed correctly, there is minimal morbidity to the patient with almost imperceptible scarring and negligible damage to the nasal mucosa.

KEY POINTS

- A complete understanding of nasal anatomy and its inherent variations is essential for optimizing outcomes of nasal osteotomies.
- The purpose of lateral nasal osteotomy is to narrow a widened lateral nasal wall, close an open roof deformity, and mobilize a deviated nasal pyramid.
- Medial osteotomies may be performed when the bony dorsum is excessively wide, the nasal bones are deviated, or the bony dorsum is excessively narrow and needs to be widened with spreader grafts.
- The nasal bony vault varies in thickness regionally, making controlled narrowing challenging; thus aesthetically pleasing and reliable results remain difficult to obtain with medial osteotomies.
- The two most frequently used techniques are the internal continuous lateral osteotomy and the percutaneous perforated lateral osteotomy, both of which should be executed with care and control, preserving soft tissue and periosteal attachments, and avoiding large subperiosteal tunnels and unnecessary undermining.
- When performing the initial exposure during rhinoplasty, undermining over the bony vault should be limited to the central dorsum to preserve soft tissue attachments to the nasal bones laterally.
- Contraindications include elderly patients with thin, fragile nasal bones, patients who wear heavy eyeglasses, patients with congenitally short nasal bones (where the caudal border is less than one centimeter below the intercanthal line), or patients with thick nasal skin and/or a history of hypertrophic scar formation. Caution should also be exercised in certain nonwhite races with low, broad noses.
- Always use a sharp osteotome (2 mm preferred). Visible scarring can be reduced by cleansing the chisel before use.
- It is imperative to remain within the initial percutaneous puncture site while extending the osteotomies to prevent increased risk of iatrogenic angular artery trauma and subsequent ecchymosis.
- After the perforated osteotomies are completed, a controlled, bimanual greenstick fracture is made to allow repositioning of the bony pyramid. Osteotomies can be performed at any point during the procedure. After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure no dorsal irregularities have been created. This is particularly important at the keystone area.
- After the osteotomized segments have been appropriately positioned, the dorsum should be reevaluated to ensure no dorsal irregularities have been created. This is particularly important at the keystone area.

- The surgeon must avoid overcompression during application of the Denver splint to prevent malposition of the osteomized segments resulting in overnarrowing of the bony vault. Care should be taken to avoid iatrogenic injury to the angular artery by sweeping down the lateral nasal sidewall in a subperiosteal plane.
- Patient management is individualized and depends on the extent of functional or aesthetic refinement; however, perioperative antibiotics, a steroid dose-pack, and activity restriction are important considerations.
- Osteotomy can be the most traumatic and least controlled with the potential for a variety of serious complications. The surgeon should therefore develop and feel comfortable with a technique offering reproducibility, consistency, and minimal morbidity.
- The percutaneous perforated lateral osteotomy technique using a sharp 2 mm, osteotome provides excellent control of the bony pyramid and is associated with a reduction in intranasal trauma.

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15

Dorsal Augmentation: Onlay Grafting Using Shaped Autologous Septal Cartilage

C. Spencer Cochran ▪ Jack P. Gunter ▪ Rod J. Rohrich

Autologous septal cartilage dorsal onlay grafts are appropriate in primary and secondary rhinoplasty patients in whom a minimal to moderate amount of dorsal augmentation is desired. Depending on the degree of augmentation required, grafts can be single layered or multilayered in the form of a V-frame, A-frame, or U-frame graft. The dorsal elevation is thus tailored to fit the imperfection at hand, resulting in a smooth, natural-looking nasal contour. The indications for each type of graft will be reviewed and the surgical technique described.

Autologous septal cartilage dorsal onlay grafts are appropriate in primary and secondary rhinoplasty patients in whom a minimal to moderate amount of dorsal augmentation is desired.

BACKGROUND

As the aesthetic evaluation of the nose has become more sophisticated, the need for dorsal augmentation in rhinoplasty has become increasingly apparent.[1-3] In the past, surgeons performing augmentation rhinoplasty were largely frustrated in their attempts to attain a natural-looking nasal dorsum using onlay grafts. Synthetic materials seem to give satisfactory results but have not been universally accepted because of the ever-present dangers of exposure and infection.[4-7] Irradiated homologous rib cartilage has been used successfully,[8] but problems with warping, absorption, and infection limit its application in the nose.[9] Autologous costal, iliac, and cranial bones have all been used to augment the nasal

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Chapter adapted from Gunter JP, Rohrich RJ. Augmentation rhinoplasty: dorsal onlay grafting using shaped autogenous septal cartilage. Plast Reconstr Surg 86:39-45, 1990.

dorsum.[10-15] Unfortunately, bone onlay grafts are difficult to shape and often undergo an unpredictable degree of absorption by the surrounding tissues. These sources are therefore reserved for the more severe nasal deformities when other graft materials are deemed unsatisfactory.

Recently there has been considerable interest in the role of diced cartilage grafts for dorsal augmentation (see Chapter 16), but controversy exists as to the long-term viability of the diced cartilage and the predictability of molding it into the desired shape.[16-19] Although diced cartilage may represent a viable means of contour restoration, at present structural grafting and moderate to large dorsal augmentations are better corrected with a more substantial grafting alternative.

Autologous rib cartilage, on the other hand, is easily carved and rarely resorbs, but it does have a tendency to warp and must be obtained from a distant donor site.[20,21] Similarly, autologous auricular cartilage must be harvested through a separate incision, and its peculiar contour renders it difficult to carve into the desired shape. Although the initial contour of the augmented dorsum may be good when auricular cartilage is used, surface irregularities often become apparent with the passage of time.

Autologous septal cartilage can be harvested from the same operative field with little increase in morbidity and is the tissue of choice for nasal augmentation if it can be shaped into the desired contour. When autologous septal cartilage is available, we have used it as a graft source for primary and secondary rhinoplasty patients requiring minimal to moderate dorsal augmentation.

INDICATIONS AND CONTRAINDICATIONS

The aesthetics of the nasal dorsum and the patient's preferences and goals must be considered to determine whether dorsal augmentation is necessary.

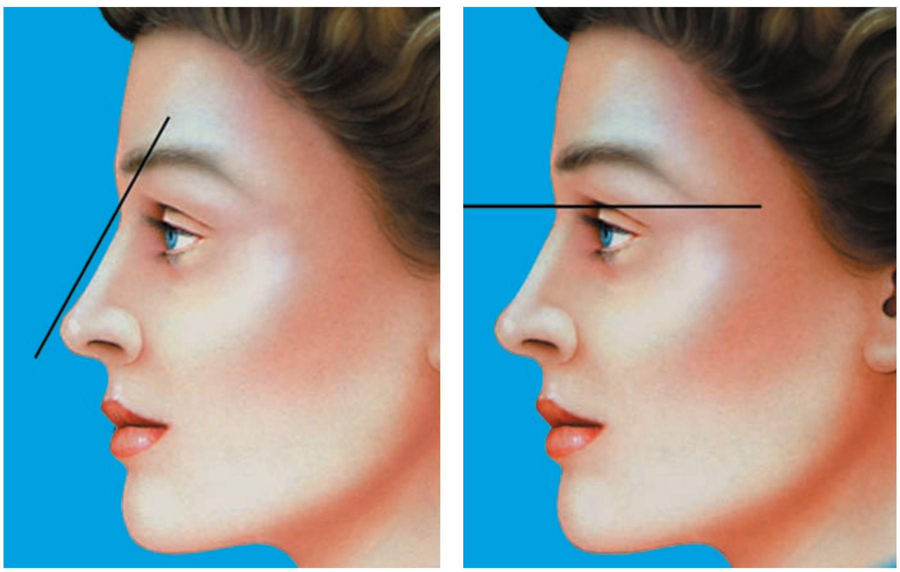
Dorsal onlay grafting is indicated in patients with a low nasofrontal angle, diminished dorsal height or an excessive concavity of the dorsal profile on lateral view.

Dorsal augmentation to widen the dorsum should also be considered in short nasal bone syndrome, as defined by Sheen and Sheen.[11] This condition is said to be present when the bony pyramid is less than one third the distance from the nasofrontal angle to the septal angle. It is accompanied by a narrow upper vault and bilateral concavities of the cartilaginous vault. Sheen[22] recommended spreader grafts to support the middle vault area, but if the nasal valves are not compromised, an alternative to spreader grafts is a dorsal onlay graft to widen the dorsum and improve the aesthetic results.[23]

Although there are no absolute contraindications to dorsal augmentation, it should be performed with caution in thin-skinned patients, because the edges of the dorsal onlay graft may become visible as a step-off or ridge over time as the soft tissue envelope contracts.

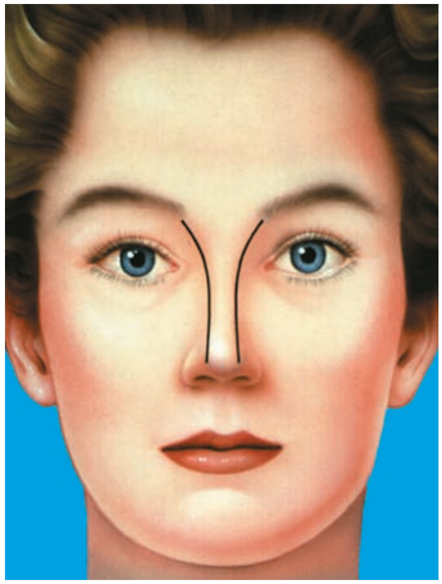
PREOPERATIVE ASSESSMENT AND PLANNING

A key component of operative planning in rhinoplasty includes assessment of the overall grafting requirements and determination of the potential source of grafting materials that will be required. Patients in whom there is little septal cartilage available or in whom multiple grafts will be required in other areas of the nose may require alternative sources of grafting material.



Analysis begins with the lateral view of the patient's preoperative photograph to determine the position of the nasofrontal angle. In white patients, the nasofrontal angle should lie between the superior lash line and the supratarsal crease on lateral view. In Asian and black patients, the nasofrontal angle should lie between the midpupillary line and the superior lash line. If the nasofrontal angle is below these levels, nasal-dorsal augmentation to raise the position of the angle should be considered. Ideally, men have a higher nasal bridge than women, and the criteria for dorsal augmentation are adjusted accordingly.

On the profile view in women, the dorsum should lie parallel and approximately 2 mm posterior to a straight line drawn from just above the nasofrontal angle to the tip-defining points, if the tip projection is normal. If a distance of more than 2 mm separates the nasal dorsum and this line or if the dorsum appears overly concave, dorsal augmentation should be considered.[3] If the tip projection requires an increase or decrease, this should be factored into the evaluation of dorsal height.



On the frontal view, the nasal dorsum should be outlined by two slightly curved, divergent lines that extend from the medial supraciliary ridges to the tip-defining points. These are the dorsal aesthetic lines. The dorsum should be of sufficient height to create a distinct anatomic separation of the eyes and give a third dimension to that portion of the face.[11]

OPERATIVE TECHNIQUE

The septal cartilage is harvested through a standard septoplasty approach.[23] After the desired length and width of the onlay graft are determined, the cartilage is cut into an oval or fusiform shape, and any irregularities of the surfaces resulting from differences in thickness are shaved. The edges of the graft should be beveled at approximately a 45-degree angle to avoid the appearance of a step-off postoperatively.

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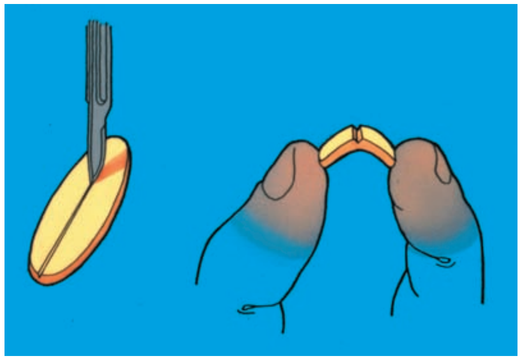
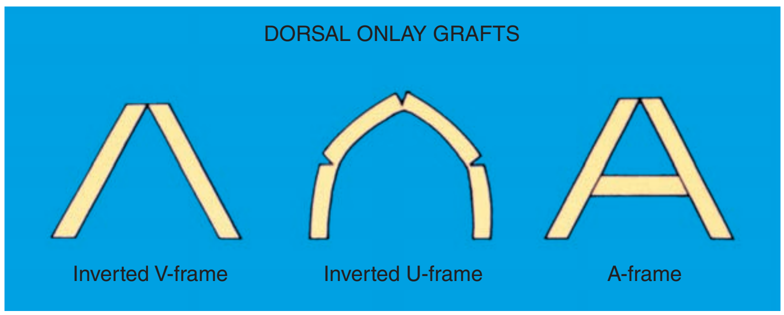


To aid in the dorsal onlay graft conforming to the contour of the dorsum, a partial-thickness longitudinal incision can be made on the surface of the graft. Digital pressure is applied along the incision until a greenstick fracture occurs.



This results in the cartilage assuming an upside-down V configuration. Alternatively, two or three partial-thickness incisions can be made to form a U-frame graft, or a piece of cartilage can be placed under a V-frame graft to form an A-frame graft. Since they are only one layer thick, however, their application is limited to patients requiring minimal augmentation.

The V-frame and U-frame grafts fit better over the arched contour of the dorsum and are more stable than a flat piece of septal cartilage.

For patients who require more nasal dorsal augmentation, a second layer of cartilage can be placed on the undersurface of the original dorsal onlay graft.[24] If more augmentation is needed at one end of the graft than the other, short strips of cartilage are placed under that end only. This procedure can be used in primary as well as secondary rhinoplasty patients.

Alternatively, one or more crossbars of cartilage can be placed under the V-frame graft between the arms of the V and be suture-stabilized to them, resulting in an A-frame graft. This increases the amount of dorsal augmentation that can be obtained, and if needed, the degree of angulation of the vertical limbs of the A-frame graft can be controlled by varying the width of the cartilage crossbar. This technique has proved useful in patients with a moderately low nasal dorsum, as is often seen after overzealous rhinoplasty.

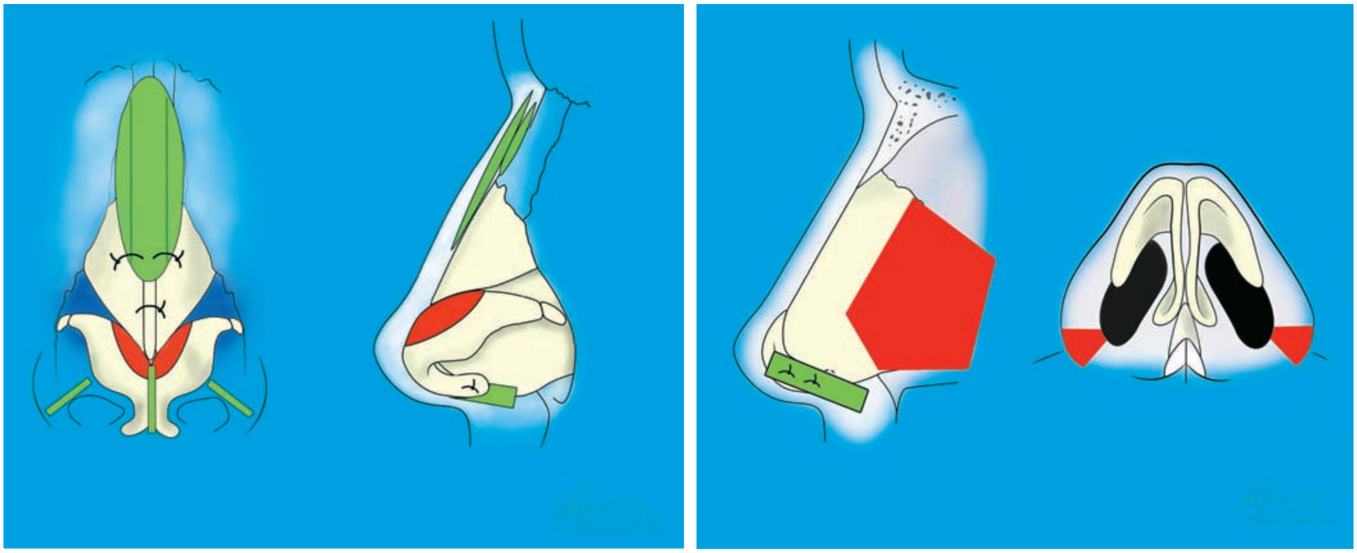
Once the dorsal onlay graft has been fabricated, the graft is placed beneath the soft tissue envelope to confirm the desired amount of augmentation. The graft should be stabilized to the osteocartilaginous framework to prevent it from shifting. Superiorly the graft can be fixated with a temporary 0.28 inch K-wire placed percutaneously through the graft and nasal bones; 2 to 3 mm of the temporary K-wire is left exposed above the dorsal skin and is easily removed with a wire twister after 1 week. Inferiorly, the graft should be suture-fixed to the cartilaginous dorsum.

CASE ANALYSES

This Asian patient presented for primary rhinoplasty. She desired dorsal augmentation and tip refinement.

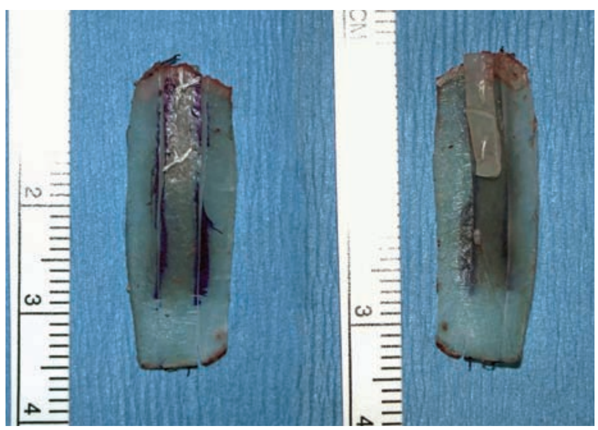
The operative goals included the following:

- Refine the tip.
- Augment the dorsum by 2 mm.
- Reposition the radix more superiorly.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Harvest septal cartilage.



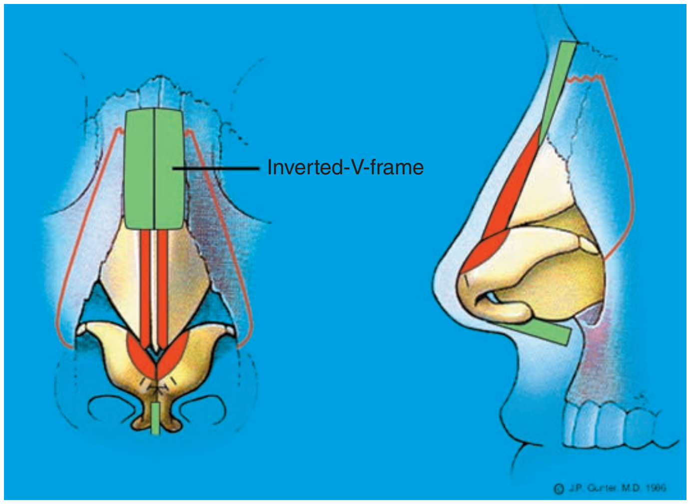
3. Augment the dorsum with a double-layered U-frame dorsal onlay graft.
4. Perform a cephalic trim of the lower lateral crura leaving a 6 mm alar rim strip.
5. Place a columellar strut graft with medial crural–columellar strut sutures.
6. Place alar contour grafts.

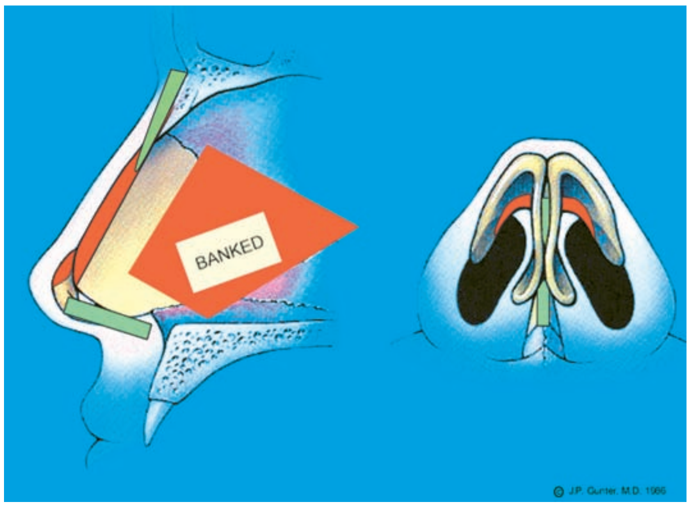
The patient is shown 12 months postoperatively. On frontal view, the improvement of her dorsal aesthetic lines is evident. The profile view shows the repositioning of her nasofrontal angle from the lower lash line to the superior lash line and dorsal augmentation.

This primary rhinoplasty patient desired minimal dorsal augmentation and tip refinement.[25]

The operative goals included the following:

- Refine the tip.
- Create a more balanced dorsum with augmentation of the upper two thirds.
- Reposition the radix more superiorly.





Surgical Plan

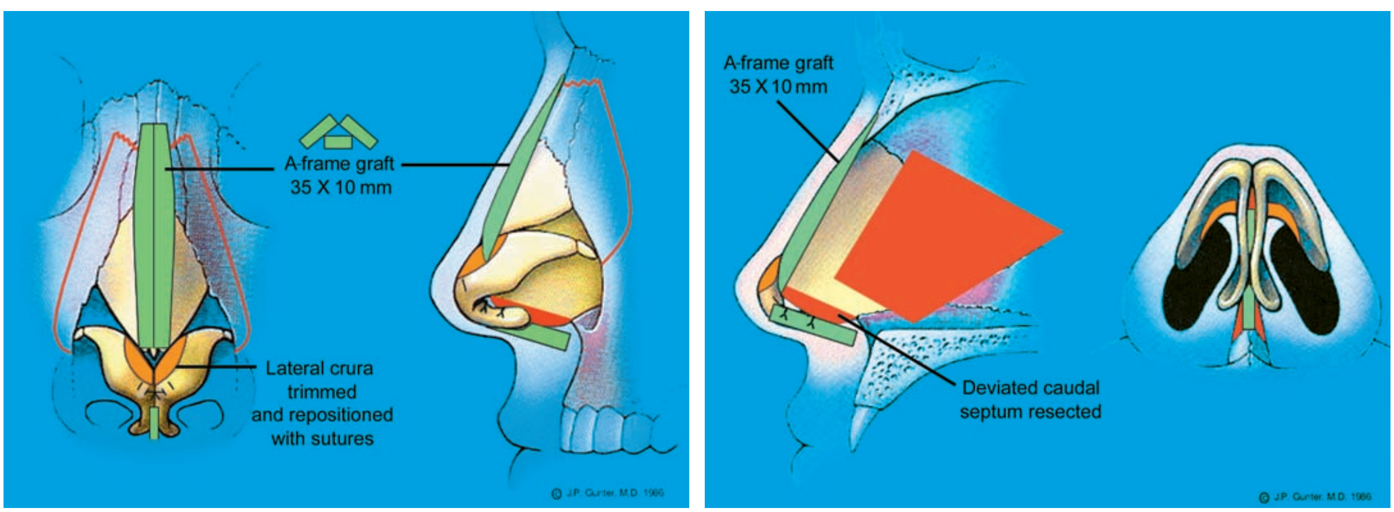
1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Reduce the lower third of the dorsum.
3. Augment the upper two thirds of the dorsum using an inverted-V-frame graft.
4. Perform a cephalic trim of the lateral crura leaving a 6 mm alar rim strip.
5. Place a columellar strut graft with medial crural–columellar strut sutures.
6. Refine the tip with transdomal sutures.
7. Perform lateral osteotomies.

The patient is shown 18 months postoperatively.[25] On frontal view, there is refinement of the dorsal aesthetic lines and tip shape. On lateral view, the dorsum appears more balanced, and there is repositioning of the nasofrontal angle to the lash line.

This patient presented for secondary rhinoplasty.[25] He was unhappy with his overreduced dorsum and unrefined, asymmetrical tip. The frontal view shows ill-defined dorsal aesthetic lines and severe tip asymmetry. On lateral view, the dorsum is overreduced and concave.

The operative goals included the following:

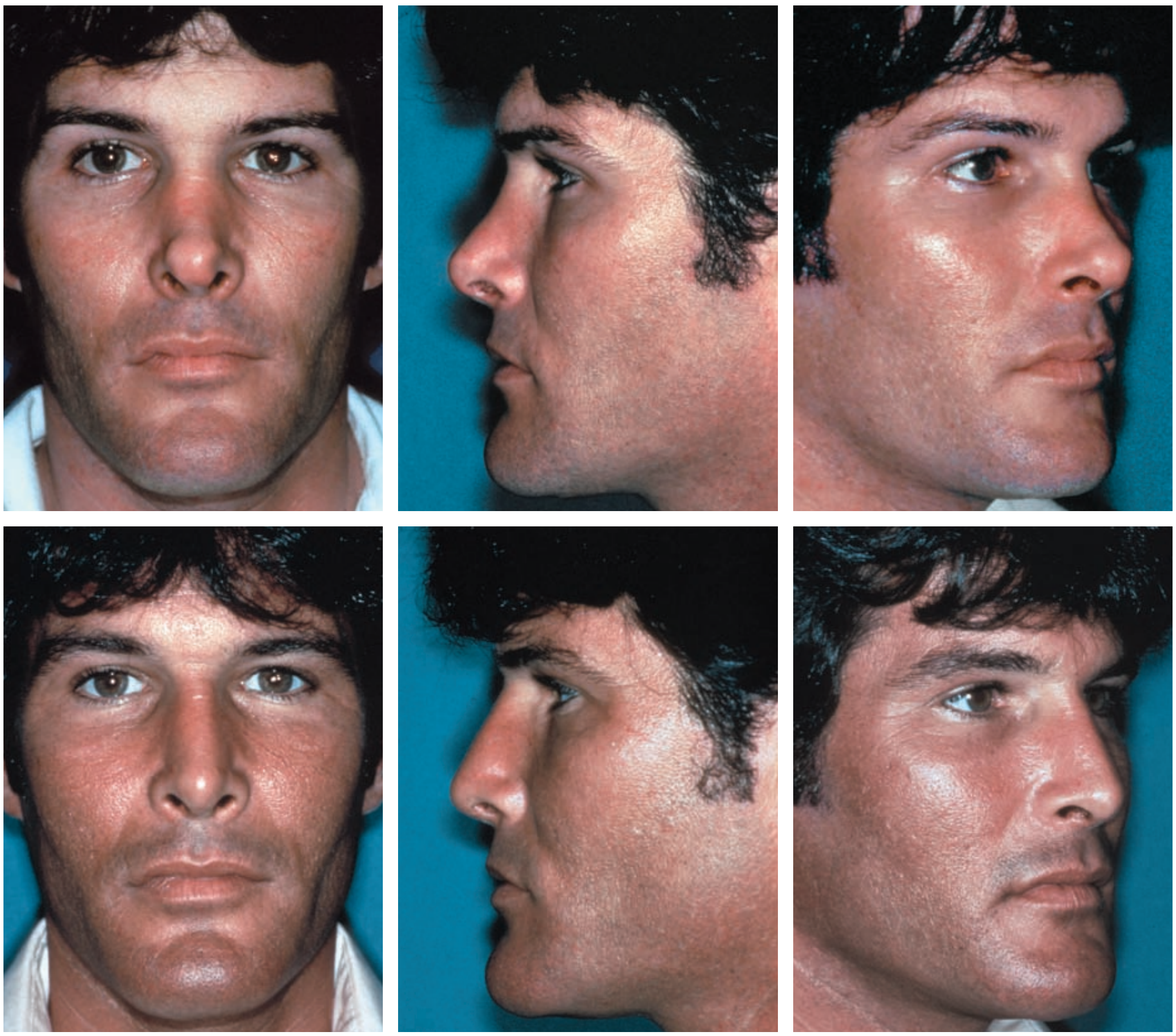
- Refine the tip.
- Create a straight dorsum with dorsal augmentation and smooth dorsal aesthetic lines.
- Reposition the radix more superiorly.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Harvest septal cartilage.

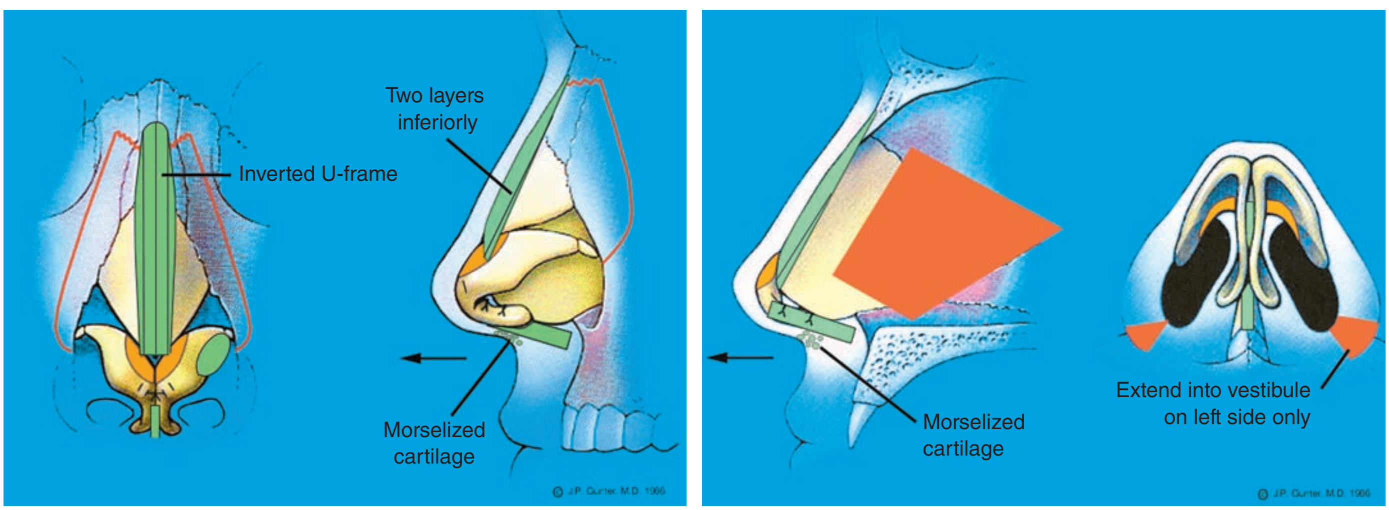
3. Augment the dorsum using an A-frame graft.
4. Perform a cephalic trim of the lateral crura and reposition with sutures.
5. Resect the caudal septum.
6. Place a columellar strut graft with medial crural–columellar strut sutures.
7. Perform lateral osteotomies.



The patient is shown 5 years postoperatively.[25] The frontal view shows smooth dorsal aesthetic lines, and a symmetrical, balanced tip. The lateral view shows a straight dorsum and superior repositioning of the nasofrontal angle.

This primary rhinoplasty patient requested improvement in her profile along with her dorsal aesthetic lines and increased tip rotation and refinement.

The operative goals included the following:
- Create a straight dorsum with dorsal augmentation and repositioning of the radix more superiorly.
- Create smooth dorsal aesthetic lines.
- Increase tip rotation and refinement.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Harvest septal cartilage.
3. Augment the dorsum using an inverted-U-frame graft.

4. Perform a cephalic trim of the lateral crura and reposition with sutures.
5. Place left alar batten graft.
6. Place a columellar strut graft with medial crural–columellar strut sutures.
7. Place morselized cartilage graft at the nasolabial junction.
8. Refine the tip with transdomal sutures.
9. Perform lateral osteotomies.
10. Perform alar base excisions.

The patient is shown 22 months postoperatively. On the frontal view, she has smooth dorsal aesthetic lines and improved tip refinement. On the lateral view, she has a balanced dorsum with a supratip break, as well as improvement in tip rotation and position of the infratip lobule.

CONCLUSION

Autologous septal cartilage dorsal onlay grafts are appropriate in primary and secondary rhinoplasty patients in whom a minimal to moderate amount of dorsal augmentation is desired. In general, better results are obtained if the total length of the dorsum from radix to septal angle is augmented rather than only a portion of it. However, if partial augmentation is all that is needed, it is important to bevel the ends of the graft and taper them to a thin edge so they will not create a step-off where they terminate on the dorsum.

It is preferable to augment the entire length of the dorsum from radix to septal angle rather than only a portion of the dorsum.

The disadvantages of using shaped autologous onlay grafts of septal cartilage for augmentation of the nasal dorsum are the limited amount of cartilage that can be obtained from the septum and the occasional difficulty in shaping the graft when dealing with a severely deviated septum because of the angulation of the septal cartilage.

KEY POINTS

- Autologous septal cartilage dorsal onlay grafts are appropriate in primary and secondary rhinoplasty patients in whom a minimal to moderate amount of dorsal augmentation is desired.
- Dorsal augmentation is based on the relationship of the dorsum to the tip projection and nasofrontal angle.
- Dorsal onlay grafting is indicated in patients with a low nasofrontal angle, diminished dorsal height or an excessive concavity of the dorsal profile on lateral view.
- The edges of the graft should be beveled at approximately a 45-degree angle to avoid the appearance of a step-off postoperatively.
- The inverted V-frame and U-frame grafts fit better over the arched contour of the dorsum and are more stable than a flat piece of septal cartilage.
- It is preferable to augment the entire length of the dorsum from radix to septal angle rather than only a portion of the dorsum.
- The only disadvantages of these techniques are the amount of septal cartilage available may be insufficient or the available cartilage may be extremely deviated, making shaping of the onlay graft difficult.

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Dorsal Augmentation: Temporal Fascia–Wrapped Diced Cartilage

Rollin K. Daniel

The use of diced cartilage grafts wrapped in fascia (DC-F) has numerous advantages and very few disadvantages.[1-3] These are autologous grafts of viable cartilage with no risk of rejection. Any combination of excised, septal, conchal, or rib cartilage can be used. In contrast to solid grafts, it is not necessary to harvest a perfect and rarely found 35 by 8 mm piece of septal cartilage or fuse two pieces of curvy conchal cartilage. Warping is not a risk, and foreign material (K-wire) is not needed. The graft is easily and quickly prepared by the circulating nurse or a junior assistant who dices the cartilage and loads the syringe. It is easily customized for thickness (1 to 8 mm), shape (tapered or uniform), and length. The ability to construct a graft with a specific shape for a specific defect is extraordinary. Molding of the graft is possible both intraoperatively and early postoperatively. The graft can be easily revised using a percutaneous No. 16 needle to remove a sharp edge, or a No. 15 blade to shave off prominences. Infection has not been a problem. Absorption has not occurred in more than 300 cases with a maximum follow-up exceeding 10 years. Over a period of months, the diced cartilage solidifies. The interspace between the diced cartilage bits is filled with fibrous tissue within the fascial sleeve. When removed, the graft is quite solid and semirigid. Pieces excised for shaping purposes are sufficiently solid for use as tip grafts. Histologic studies confirm that the individual pieces of cartilage have survived and suggest that the fascia has become a neoperichondrium.[4]

DC-F grafts have several distinct advantages over other techniques in rhinoplasty surgery for dorsal augmentation.

BACKGROUND

A discussion of the role of diced cartilage grafts in rhinoplasty surgery requires a review of several important points. First, the fundamental technique is not new. The use of diced cartilage alone, without a fascial sleeve, was extremely popular in Europe between the World Wars, with numerous surgeons developing cartilage dicers and chondrojet injectors.[5,6]

Second, many surgeons have used the technique for over 25 years and are pleased with its long-term viability.[2,7] One of the most impressive uses of diced cartilage is cranioplasty, which demonstrates that the individual pieces coalesce into a semirigid graft with time.[8] Third, the term *diced cartilage graft* can encompass a wide variation as to type of cartilage, method of preparation, and containment, which leads to confusion when comparing clinical indications, techniques, and results.[9] A discussion of each of these points is essential.

It is critical to create a symmetrical dorsal platform on which to place the DC-F graft. The graft acts as a capstone to a pyramid; if the pyramid is crooked, the DC-F graft will appear to be displaced.

Cartilage

I use only autologous cartilage, which can be derived from excised material, septum, or distant grafts (conchal or rib). I see virtually no justification for routine use of cadaver cartilage grafts with their known long-term absorption.[10] Under exceptional situations of age, ethnicity, or systemic risks, cadaver cartilage warrants consideration. These account for less than 1% of cases.

The length, width, thickness, and shape of the construct must be carefully designed.

Preparation

The cartilage should be diced—never morselized, bruised, or crushed. The goal is complete graft survival, similar to a columellar strut or spreader graft. The cartilage is cut into 0.5 mm or smaller cubes using two 11 blades and then inserted into a small tuberculin syringe for easy placement. The cartilage should be diced so fine that it can be ejected from the syringe (positive spurt test).

The shape of the graft can be either uniform or tapered. Tapered graft is thicker cephalically or caudally. The shape should be as accurate as possible before insertion. Surgeons should not expect to create the ideal shape with molding.

Containment

Diced cartilage alone can be placed directly into a tight pocket for contour, layered on either side of a rigid dorsal graft for blending, or placed in parapiriform pockets to advance the midface. When it is used as dorsal or radix grafts, I prefer to wrap the diced cartilage in autologous fascia to confine the graft, smooth irregularities, and encourage it to function as a neoperichondrium. I tried the Turkish delight method described by Erol,[11] and absorption with clinical failure occurred in all cases, which I attributed to a foreign body reaction to Surgicel.

Diced cartilage grafts are not new. They have been used ever since modern plastic surgery began. For the past decade, I have used DC-F rather than solid dorsal grafts for dorsal augmentation.

INDICATIONS AND CONTRAINDICATIONS

During the past 10 years, the indications for using DC-F have expanded to include the entire range of rhinoplasty cases without restriction as to age (14 to 68 years), ethnicity, cause, or number of prior surgeries.

Dorsum

Diced cartilage has dramatically revolutionized dorsal grafts in rhinoplasty surgery. Compared with rigid cartilage grafts, it is a far simpler technique, quicker (15 minutes versus 1 to 2 hours), more flexible as to height (2 to 8 mm) and length (5 to 40 mm), and has fewer postoperative problems and in my opinion superior aesthetic results. As shown in case studies, DC-F has truly changed what can be achieved in primary cases that require very refined grafts. The indications in primary cases include low dorsum, ethnic nose, and partial-length grafts in the radix/dorsum.[12,13] In secondary cases, diced grafts have survived despite numerous prior operations and in cases in which cadaver cartilage has failed. The indications for DC-F grafts in secondary cases can be divided into the categories of *contour augmentation* and *composite reconstruction.* A contour augmentation is

designed to create an ideal dorsal aesthetic profile. A composite reconstruction is composed of a deep structural layer to provide nasal support with an overlying aesthetic layer of DC-F that achieves the final dorsal contour.[14,15]

A DC-F construct is carefully* placed *in the nose using percutaneous sutures. The skin is redraped and the contour checked. Pieces of cartilage can be removed from the open caudal end to achieve final shape.

Radix

My initial interest in using Turkish delight grafts was to replace the need to harvest fascia for radix grafts.[11] The failure of these grafts in my 20 cases led me to use DC-F grafts in the radix. Based on my prior overcorrection with Turkish delight grafts, I overcorrected my initial six DC-F grafts and had to reduce them. Subsequently, some of the DC-F grafts in the radix were visible, especially in patients with very active eyebrow excursion. I have reduced two cases. Thus I tend to use fascia alone for minor and moderate-sized radix grafts. I reserve DC-F grafts for major radix defects and half-length radix/dorsal grafts. Visibility has not been a problem in these cases probably because of thicker skin in the former and more caudal placement in the latter.

When the shape of the dorsum is satisfactory, a Denver splint is applied with the foam pad, helping to ensure a smooth dorsum. When the cast is removed, the patient is instructed not to massage the nose or wear glasses for 4 to 6 weeks.

There are no specific contraindications if dorsal augmentation is required. I have used DC-F grafts for immediate reconstruction after removal of infected silicone implants, extensive nasal collapse in cocaine patients, and under extremely thin, scarred skin envelopes. Perhaps the best validation of the technique is that for the past decade I have placed DC-F exclusively for dorsal augmentation and no longer use solid dorsal grafts.

DC-F grafts can be used in the entire range of rhinoplasty cases, from primary cases requiring augmentation to unexpected defects encountered in secondary cases to composite reconstruction for a collapsed nose, and for burned out cases requiring an aesthetic reconstructive rhinoplasty.

PREOPERATIVE ASSESSMENT AND PLANNING

Preoperative planning for a DC-F graft is the same as for any rhinoplasty. I discuss the need for grafts with every patient. All primary patients must sign for the harvesting of fascia and ear cartilage, and all secondary patients must also agree to a rib graft. I find that drawing basic angles (nasofacial, tip, and columellar inclination) and lengths (tip projection and ideal dorsum) on full-size photographs is helpful.[16] Photographic analysis and planning are extremely valuable for determining ideal and realistic results. Planning in secondary cases is obviously more complex, especially those requiring composite reconstruction. These are incredibly difficult cases that are often an aggregate of a difficult primary followed by a failed secondary rhinoplasty. Frequently, septal support is absent or compromised, with perforations an all too common occurrence. Preoperative preparation and planning must be thorough. I try to obtain the previous operative reports. I summarize the previous operations on a Gunter diagram, using a different-colored ink for each one, and display it with the patient's photographs in the operating room. CT scans can be invaluable for assessing the bony vault. A written step-by-step operative plan helps surgeons to determine the essential steps in advance.

Preoperative planning can include photographic analysis using angles and lengths, CT scans, and a review of previous operative reports.

OPERATIVE TECHNIQUE

Diced cartilage has revolutionized dorsal grafting. The basic concept is to dice cartilage into small bits (less than 0. 5 mm) that can be placed into a fascial sleeve that is slipped into the dorsal defect.

A graft will solidify within a matter of months and can be easily trimmed or removed in its entirety, shaped, and reinserted as necessary.

Fascial Harvest

The largest possible sheet of deep temporal fascia is harvested. I draw a straight line directly up from the tragus and then mark a 2.5 cm transverse posteriorly oriented ">" incision whose apex touches the line. The incision is thus placed behind the anterior temporal vessels, and when retracted, the V shape provides

greater access than a straight line. The facial incision extends superiorly to the periosteal junction, anteriorly to the deep temporal fascial split, then inferiorly toward the concha, and posteriorly as far back as possible. The fascia is swept off the underlying muscle. A small vein is present at the 5 o'clock position. This can be preserved or cauterized. The wound is closed in layers and the staples removed 1 week postoperatively. Extensive experience has been reported on the use of diced cartilage wrapped in cadaver fascia (Tutoplast; Davol Inc., Bard Inc., Warwick, RI), and some authors have reported on the use of acellular dermal matrix (AlloDerm; LifeCell, Branchburg, NJ).

Deep temporal fascia should be harvested in as large a piece as possible, often measuring 5 to 6 cm vertically by 6 to 8 cm transversely. Fascia contracts dramatically!

Dicing the Cartilage

Excised cartilage (dorsum, alar, septal, conchal, and rib) is diced into bits smaller than 0.5 mm. In general, the *circulating nurse* puts on sterile gloves and dices the cartilage into squares while the surgeon continues to operate. It is important to cut the cartilage with two No. 11 blades without traumatizing it (that is, without overmorselizing or crushing it). A 1 cc tuberculin syringe is filled with diced cartilage. The plunger is inserted, and the cartilage is compressed maximally. Fluid and air can be removed by inserting a No. 25 needle through the opening and compressing the cartilage. The cartilage should be diced so fine that it moves through the hub of the syringe, thus passing the spurt test. Because the cartilage is so finely diced, the hub does not have to be cut off of the syringe with a No. 10 blade. If diced cartilage alone is used to build up the piriform area, then the cartilage can be diced less fine (1 to 2 mm) and the hub removed.

The cartilage cannot be diced too fine. It is compressed until it is virtually a solid paste and can be passed through the hub of a tuberculin syringe.

Constructing the Fascial Sleeve

The dorsal defect is measured so that an exact DC-F construct can be made on the back table and inserted into the defect. The fascia is pinned on a Silastic block and folded into an 8 to 10 by 20 to 35 mm sleeve. The cephalic end is sutured at its corners using two sutures of 4-0 plain on straight SC-1 needles. Then the free

edge is trimmed and sutured closed with a locking suture of 4-0 plain catgut. This sleeve is similar to a double-layer dorsal fascia graft. Multiple methods are available for making the construct, but I prefer to fill the sleeve with highly compressed diced cartilage as opposed to folding the fascia over a mound of loose, diced cartilage.

The fascial sleeve is made to measure to fit the defect. The fascia is pinned to a Silastic block under slight tension and folded to a width of 8 to 10 mm. The length is determined by the size of the dorsal defect.

Filling the Construct

Compression of the cartilage is confirmed, and the syringe is slipped into the open end of the sleeve. The diced cartilage is injected into the sleeve until the desired thickness is obtained. The critical step is to achieve very specific dimensions of thickness (1 to 8 mm), length (10 to 40 mm), and shape (tapered or uniform). The nondominant hand is used to mold the cartilage as it is slowly injected into the sleeve with the dominant hand. The length of the dorsal graft is trimmed to the exact length required. It is important to mold the graft to the exact dimensions and not overgraft the nose.

The goal is to create a dorsal graft with ideal dimensions and contour. The volume of cartilage will determine the height, whereas the curved, natural contour is achieved with the nondominant hand at the time of filling. The dorsum should **not** ***be overgrafted, because the graft will not be absorbed!***

Inserting the Graft

The percutaneous sutures are inserted at the nasion level, and the shaped graft is slipped into the recipient bed. The graft is held at its cephalic end and molded from cephalic to caudal. If necessary, diced cartilage can be expressed out of the fascial sleeve. Then the skin is redraped and the dorsal contour evaluated. The supratip area is checked to ensure that the graft has not widened. I often use suction to remove cartilage from the open end of the graft. The graft is then closed and fixed to the cartilage vault with a 4-0 plain catgut suture. In general, I prefer to achieve the exact dimensions of the construct on the back table and minimize molding.

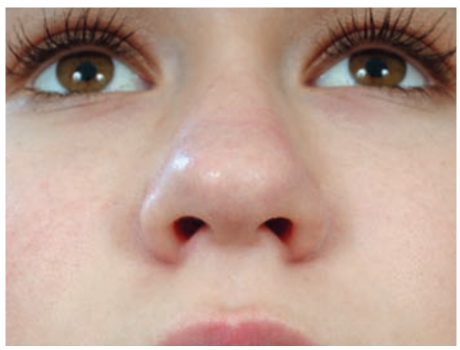
Time is taken to create the ideal-shaped construct while it is on the back table. Surgeons should not expect to make major changes by molding the graft once it is in the nose.

Ten Technical Tips to Minimize Problems With Diced Cartilage Grafts Wrapped in Fascia

1. Thin skin is a greater challenge than thick skin. If the skin is very thin (steroid damaged), then an overlay graft of fascia above the DC-F graft should be considered.
2. The bony cartilaginous vault needs to be smooth and straight before insertion of the DC-F graft. Lateral wall asymmetry is corrected with appropriate osteotomies and spreader grafts.
3. Some surgeons prefer to use a set of Silastic dorsal implant sizers to determine the approximate shape of the DC-F graft to be constructed.
4. The dorsal construct is designed to fit the defect (length, width, and height) and is built on the back table. The cartilage must be diced extra fine so that it can be squirted out of a tuberculin syringe. The cartilage needs to be rigidly compressed in the syringe before it is placed in the fascial sleeve.
5. The shape is controlled at the time of fill. Will it be uniform, caudally tapered, or cephalically tapered? In a uniform graft, the fill is even from one end to the other. In tapered grafts, pinching with the nondominant thumb and index finger controls the amount of cartilage and produces a gentle dorsal curve.
6. The *cephalic end* of the DC-F graft should not extend above the nasion. To create a nasofrontal angle, a separate radix graft is placed first, followed by a DC-F graft along the dorsum.
7. The *middle portion* of the DC-F graft must not be overfilled. Prior overresection of the dorsum is usually at the caudal end. The skin at the rhinion is thin, which can lead to visibility. These grafts are not resorbed—what the surgeon sees on the table is what the patient will see.
8. The caudal end should not be overfilled, especially if molding of the graft in situ has forced the diced cartilage toward the open, caudal end. Suction is used to incrementally remove excess diced cartilage, the end is tapered, and the construct is closed with a 4-0 plain suture.
9. If a small irregularity is present when the cast is removed on day 6, the dorsal graft is molded digitally and a new Denver splint is applied with its foam under pad. This is left in place for 2 to 3 days. The process is repeated once more if necessary.
10. If a surgical revision is necessary 1 year later, a closed approach is considered to treat minor irregularities (visible edges or volume reduction from the undersurface of the graft). An open approach is reserved for major changes, which are usually associated with other requirements. DC-F grafts are solid at a year, and the dissection plane between fascia and subcutaneous tissue is easily found if removal is necessary.

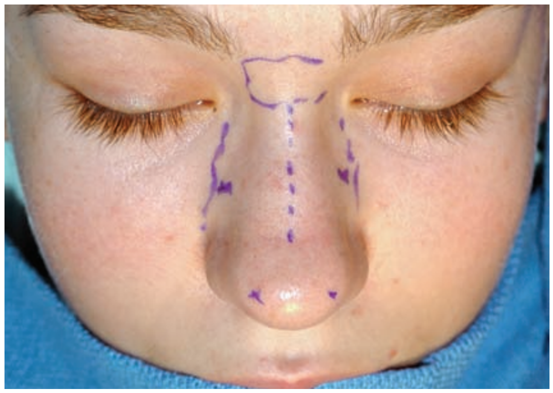
CASE ANALYSES



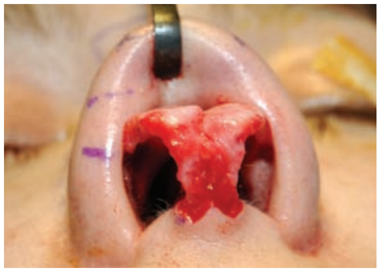
This 15-year-old girl presented for a cosmetic rhinoplasty. She thought that her nose was too wide and flat and that her tip had no definition. On the anterior view, her nose looked flat. Her dorsal aesthetic lines were progressively more divergent from radix to rhinion to tip. Her tip was 22 mm wide. On the lateral view, her nose looked long with a dependent tip and a flat dorsum. Her chin was retruded. Flatness of the bridge was evident on the oblique view. Her tip appeared droopy and her chin retruded. On hemibasal views, her tip was very amorphous and the nostrils had a reverse-teardrop appearance.

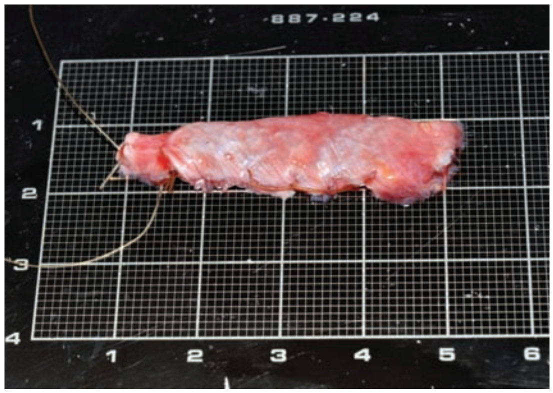
Because the patient wanted a more refined "model's nose," the goal was to narrow the dorsum and tip as much as her tissues allowed. Specifically, the dorsum will be narrowed using paramedian osteotomies and a curved DC-F graft for slight augmentation. The patient agreed to a small chin implant.



Surgical Plan

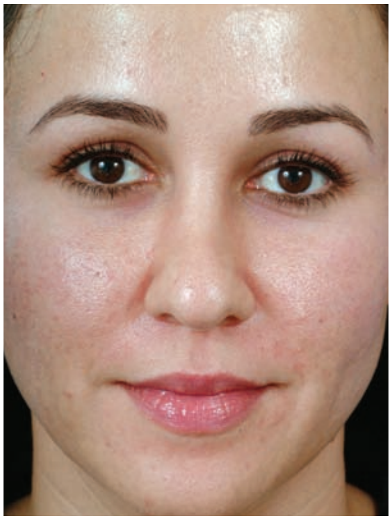
1. Insert a small chin implant through a submental incision.
2. Harvest a sheet of deep temporal fascia.
3. Make initial bilateral infracartilaginous incisions for subcutaneous dissection over the lobule.
4. Using an open approach through the transcolumellar incision, elevate the skin and defat tissue off the underlying cartilages.
5. Make a right transfixion incision for septal exposure and harvest.
6. Reduce the left inferior turbinate using coblation plus outfracture of both inferior turbinates.
7. Narrow the dorsum from 11 to 6 mm using paramedian and low-to-high osteotomies.
8. Mark the midline.
9. Mark the desired width of 6 mm at the bony-cartilaginous junction.

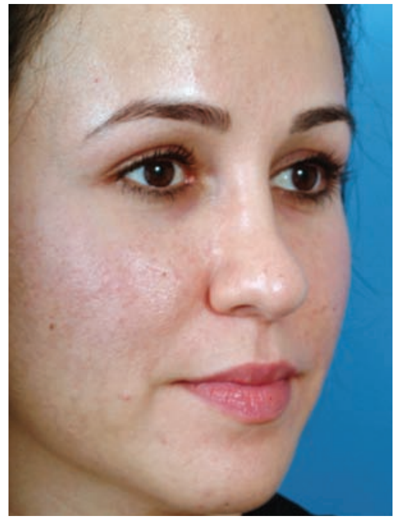




10. Cut the cartilage vault along a tapered line from the anterior septal angle to the junction.
11. Use a straight osteotome for paramedian cuts a maximum width of 3 mm on either side.
12. Insert a columellar strut.
13. Shape the tip with the following sutures: columellar, domal creation, interdomal, domal equalization, tip position, and lateral crural convexity.
14. Use a shield-shaped graft plus a small booster graft for additional tip definition.
15. Insert a radix graft of fascia.
16. Construct and insert a *uniform* DC-F graft that measures 30 by 7 by 2.5 mm for dorsal augmentation.
17. Close all incisions and apply a cast.

One year postoperatively, the patient's nose is narrower on anterior view, and her dorsum is more curved on oblique view. Her nose is shorter and the tip more rotated on lateral view. On the basal view, her tip is more triangular and less amorphous. A narrower, natural-appearing dorsum has been created using a DC-F graft.






This 35-year-old woman presented 2 years after a primary closed rhinoplasty. During the early postoperative period, she had three Kenalog injections to her supratip region. She was devastated by the result and described her nose as too long and her tip as that of a "clown nose." She also related, "My mother won't look me in the eye." Essentially, the patient wanted her old nose back, with a strong bridge and a small bump. On the anterior view, the dorsal lines were pinched in the middle third, worse on the left than the right, which made her tip appear rounder. On the lateral view, the dorsum looked overresected, and the pollybeak tip was evident. The oblique view showed that the dorsal line was broken at the midvault, and her tip appeared dependent.

In planning the surgery, two important technical issues had to be determined. First, from the physical examination, it was evident that the patient's left nasal bone was inwardly displaced. If a perfectly straight dorsal graft were placed on an asymmetrical base, it would appear crooked. The challenge was to change the orientation of the left bone from vertical to angled, move it outward, and maintain the position.

Second, what type of dorsal augmentation was needed? On preoperative examination, her septum felt weak and had indeed been partially resected. Would this augmentation require conchal cartilage or rib? A straight, soft profile can be created with a *tapered* DC-F graft, but the patient wanted a strong profile with the suggestion of a hump, thus favoring a *uniform* DC-F graft.

Surgical Plan

1. Harvest a large sheet of deep temporal fascia.
2. Perform an open approach through transcolumellar and infracartilaginous incisions.
3. Excise 3.5 mm of supratip scar tissue (soft tissue pollybeak).
4. Explore the septum through a right unilateral transfixion incision.
5. Harvest available cartilage, leaving a 10 to 12 mm strut.
6. Harvest the conchal bowl through a retroauricular incision.
7. Perform a medial oblique and low-to-low osteotomy on the left side only.
8. Insert a partial-length (distal) spreader graft on the right and a full-length spreader graft on the left, extending into the bony vault to maintain the outward position of the left bone.
9. Insert a laminated columellar strut made of conchal cartilage reinforced with septal cartilage.
10. Reduce the alar cartilages to 6 mm rim strips.
11. Shape the tip with domal creation and interdomal sutures.
12. Apply a shield-shaped tip graft with a posterior boost made from septal cartilage plus a dome-shaped tip refinement graft made from excised alar cartilage.
13. Dice scraps of cartilage and pack them into a tuberculin syringe on the back table.
14. Build a DC-F construct the measures 32 mm long by 8 mm wide by 5 mm thick.
15. Ensure *uniform* thickness to create a strong profile and minihump. (In a typical secondary rhinoplasty, a *tapered* DC-F graft is used to prevent fullness in the rhinion area.)
16. Insert alar rim grafts.
17. Close all incisions and apply a cast.

Almost 2 years postoperatively, the patient's nose essentially appears as it did before her first operation. The patient and her family are pleased with the result. On the anterior view, her bony pyramid is no longer collapsed on the left side. On the lateral view, her dorsum has a natural unoperated contour with a small minihump and a nice setoff of the tip. On oblique view the dorsum is strong with a well-defined dorsal line. The tip is no longer dependent and broad.

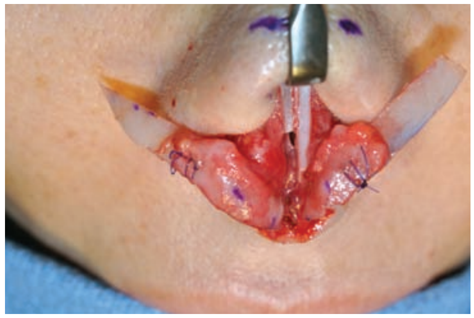
This case illustrates two of the principal advantages of DC-F grafts. The graft is composed of scraps of cartilage rather than a solid piece. This patient's septum had been compromised, and 5 mm of augmentation with conchal cartilage was virtually impossible. The only alternative was a rib graft. This was not needed, because a DC-F graft was performed. In addition, the flexibility of shaping DC-F allows surgeons to design each construct to fit the patient's goal, including the

creation of a small hump on top of a major augmentation. Interestingly, the patient stated that further distinct improvement in tip definition occurred 12 to 20 months postoperatively, thus confirming that the skin envelope continues to thin without the need for Kenalog injections.

This 57-year-old woman presented for a secondary rhinoplasty 14 years after her original surgery, which was performed elsewhere. She did not like the surgical look of her nose, especially the pinched, droopy tip. On the anterior view, her dorsum was collapsed in the midvault, whereas the tip has a classic hanging columella (seagull in flight). On the lateral view, her dorsum appeared overresected and the alar rims retracted. On the oblique view, her tip looked flattened as though pressed against a glass window. Deviation of the caudal septum and destruction of the left soft tissue facet were apparent on the basal view. This patient had a four-view disaster with major deformities in each view of her nose.

The operative goals included the following:

- Harvest a sheet of deep temporal resection.
- Expose the nose using an open approach.
- Analyze the tip. (This revealed a prior resection of 90% of the lateral crura.)
- Excise the supratip scar tissue. (This revealed a cartilaginous pollybeak.)
- Excise a tapered 2.5 mm section of cartilaginous dorsum.
- Expose the septum.
- Resect a 6 mm wide bowed section of the caudal septum.
- Harvest the cartilaginous body of the septum.
- Harvest a portion of the conchal bowl (to be diced by the circulating nurse).



- Insert bilateral spreader grafts and suture them into place with multiple sutures of 4-0 PDS.
- Mobilize the alar cartilages from the underlying mucosa.
- Suture the lateral crural strut grafts to the remnants of each lateral crus.
- Insert a columellar strut.
- Shape the tip with the following sutures: columellar, domal creation, and domal equalization.
- Construct a dorsal DC-F graft on the back table with thickness *tapered* from 1.0 mm cephalically to 1.5 mm at the midpoint to 2.3 mm caudally.
- Insert the DC-F construct using percutaneous guide sutures at the nasion and fix/close the graft caudally at the anterior septal angle using 4-0 plain catgut.
- Provide additional tip projection with a two-layer onlay tip refinement graft covered with a piece of fascia.
- Make marginal incisions along each alar rim, fully transpose the lateral crura, and suture the lateral crural strut grafts to the alar rims.
- Insert Doyle splints and apply a Denver splint.

Postoperatively DC-F grafts provide a smooth dorsum with significant augmentation, a natural contour, and well-defined dorsal lines.

The patient is pleased with her result 1 year 3 months postoperatively. On the anterior view, her nose appears shorter and the hanging columella is corrected. Her collapsed midvault with its disrupted dorsal lines is replaced with very visible parallel dorsal lines. On the oblique view, her long verticalized tip is compressed into a very well-defined domal-tip complex. Her dorsum is smooth and blends into the radix. On static and smiling lateral views, her dorsum is straight and tip dependency is eliminated.

This 52-year-old woman had a rhinoplasty at age 17 and was disappointed with the result immediately. A revision 1 year later did not make a significant improvement. Her respiration was significantly impaired. On internal examination the vestibular and internal valves were collapsed. On the anterior view, her nasal tip was extremely pointy with a very sharp bossa. Midvault collapse was evident on the oblique view. On the lateral view, her dorsum looked overresected and had a characteristic ski-slope curvature. The basal view showed a pointy tip and distorted nostrils. This was one of my first DC-F graft surgeries, performed over 10 years ago.

Surgical Plan

1. Assess the septum via a right unilateral transfixion incision. (This confirmed a prior submucous resection of a portion of the septum.)
2. Perform an open approach, which requires meticulous dissection and multiple reinjections of the tip to allow safe skin elevation.
3. Assess the tip. (This revealed a prior Goldman tip procedure; that is, transection of the lateral crura, followed by midline suturing to create a central "tent pole" or pointy tip.)
4. Slightly reduce the distal cartilaginous pollybeak.
5. Harvest all available septal cartilage.
6. Harvest the cartilaginous portion of the fifth rib.
7. Insert a columellar strut.
8. Reverse the medial transposition of the lateral crura by repairing the divided alae at the dome.
9. Suture lateral crural strut grafts to the distal lateral crura, and then rotate them into the alar bases.
10. Place an additional alar rim structure graft on the left.
11. Place a concealer graft over the tip in the infralobular position.
12. Dice cartilage and place it in a tuberculin syringe.
13. Suture a fascial sleeve around the syringe.
14. Insert diced cartilage under the dorsum, and expand it to the desired augmentation.
15. Close the graft caudally.
16. Make 2 mm nostril sill excisions.
17. Suture footplate grafts to the columellar base.
18. Close all incisions and apply a cast.

Almost 10 years postoperatively, and without revisions, the patient's dorsum looks natural with its dorsal lines. She has maintained 4 to 5 mm of augmentation from day 1, without absorption. Intraoperatively every secondary rhinoplasty is a surprise and requires flexibility. Reversal of the Goldman tip and coverage of the suture repair with a concealer graft was devised out of necessity. Because this was one of the first DC-F grafts that I performed, it raises the question, "Why

did I switch from the *syringe injection* technique to the *construct* technique?" The injection technique works surprisingly well when a *uniform* graft is required to create a straight profile, and the patient has a tight skin envelope. However, it does not work well in most secondary cases, in which the dorsal defect is more distal and a *tapered* augmentation is needed. Based on experience and unsatisfactory results, I no longer inject graft in situ and strongly favor building a *construct* on the back table.

POSTOPERATIVE CARE

After completion of the operation, all incisions are closed and the dorsum is gently taped with Steri-Strips. I prefer to use a Denver splint rather than an acrylic splint. The foam is positioned along the dorsum, and the previously bent splint is gently placed on top. The pressure from the splint further ensures a smooth dorsum. When the cast is removed 6 days postoperatively, the nose is inspected and gentle molding can be carried out as needed. If required, the patient is seen every 2 days for graft molding for up to 14 days. Patients are informed not to wear sunglasses for 6 weeks. If asymmetry is present 1 year postoperatively, it can be easily shaped by beveling with a 15 blade. Alternatively, the now-solid graft can be removed, shaped, and reinserted.

COMPLICATIONS

After a decade of experience with DC-F grafts, I have seen no evidence of absorption and no warping. To date, the problems with diced cartilage grafts have been more technical rather than intrinsic to the graft itself. A correlate from traditional rhinoplasty surgery is the visibility of the cephalic end of a spreader graft, which is not the fault of the graft. My problems with diced cartilage grafts have been relatively minor and easily corrected. They include visibility of DC-F grafts placed in the radix area, especially in patients with very active eyebrow elevation (more than 15 mm). It is easily corrected under local anesthesia either by reduction with a pituitary rongeur or excision and replacement with fascia alone. For dorsal grafts, *edge show* occasionally occurs in the rhinion area, whereas caudally, inadequate grafting of the supratip region is sometimes seen. The former is probably caused by poor technique and the very thin skin in the rhinion area. It is easily corrected under local anesthesia in the office using a pituitary rongeur. In one patient, who had a very thin skin envelope, I placed a layer of fascia between the skin and the intact DC-F graft in a revision. In the rhinion area of the graft, a greater prominence than desired can be present. This can be prevented by making a very tapered construct with minimal fill at the midpoint and *laying* the graft into the defect rather than stuffing it in and molding it. Occasionally a minor depression develops in the supratip area, the result of an initial undercorrection in an attempt to create an immediate supratip break. Over time, I have learned

to maintain the full graft length and not shorten it to achieve tip setoff. If a depression occurs, I correct it with a small fascia graft; other surgeons might prefer AlloDerm. Also, I am now more compulsive about checking for graft widening in the supratip area. This can occur after manual molding of the graft, which forces cartilage from cephalad to caudal. Thus far patients have not complained about it. This experience is in marked contrast to more rigid dorsal grafts that can have serious problems, including warping, malalignment, K-wire extrusion, and total visibility from skin shrink-wrapping around the graft.

Complications with diced cartilage grafts tend to be relatively minor and confined to shape and visibility problems, not absorption.

CONCLUSION

DC-F grafts have dramatically revolutionized dorsal grafts in rhinoplasty surgery. In my personal experience, they have replaced layered 35 by 6 mm septal grafts, stacked conchal grafts, and carved costal cartilage grafts. DC-F is technically straightforward, simpler, quicker, and often aesthetically superior to solid cartilage grafts, without the risk of warping, malalignment, and K-wire extrusion. In over 300 patients with follow-up exceeding 10 years, I have seen no evidence of graft absorption.

KEY POINTS

- DC-F grafts have several distinct advantages over other techniques in rhinoplasty surgery for dorsal augmentation.
- It is critical to create a symmetrical dorsal platform on which to place the DC-F graft. The graft acts as a capstone to a pyramid; if the pyramid is crooked, the DC-F graft will appear to be displaced.
- The length, width, thickness, and shape of the construct must be carefully designed.
- The *shape* of the graft can be either uniform or tapered. Tapered graft is thicker cephalically or caudally. The shape should be as accurate as possible before insertion. Surgeons should not expect to create the ideal shape with molding.
- Diced cartilage grafts are not new. They have been used ever since modern plastic surgery began. For the past decade, I have used DC-F rather than solid dorsal grafts for dorsal augmentation.
- A DC-F construct is carefully *placed* in the nose using percutaneous sutures. The skin is redraped and the contour checked. Pieces of cartilage can be removed from the open caudal end to achieve final shape.

- When the shape of the dorsum is satisfactory, a Denver splint is applied with the foam pad, helping to ensure a smooth dorsum. When the cast is removed, the patient is instructed not to massage the nose or wear glasses for 4 to 6 weeks.
- DC-F grafts can be used in the entire range of rhinoplasty cases, from primary cases requiring augmentation to unexpected defects encountered in secondary cases to composite reconstruction for a collapsed nose, and for burned out cases requiring an aesthetic reconstructive rhinoplasty.
- Preoperative planning can include photographic analysis using angles and lengths, CT scans, and a review of previous operative reports.
- A graft will solidify within a matter of months and can be easily trimmed or removed in its entirety, shaped, and reinserted as necessary.
- Deep temporal fascia should be harvested in as large a piece as possible, often measuring 5 to 6 cm vertically by 6 to 8 cm transversely. Fascia contracts dramatically!
- The cartilage cannot be diced too fine. It is compressed until it is virtually a solid paste and can be passed through the hub of a tuberculin syringe.
- The fascial sleeve is made to measure to fit the defect. The fascia is pinned to a Silastic block under slight tension and folded to a width of 8 to 10 mm. The length is determined by the size of the dorsal defect.
- The goal is to create a dorsal graft with ideal dimensions and contour. The volume of cartilage will determine the height, whereas the curved, natural contour is achieved with the nondominant hand at the time of filling. The dorsum should *not* be overgrafted, because the graft will not be absorbed!
- Time is taken to create the ideal-shaped construct while it is on the back table. Surgeons should not expect to make major changes by molding the graft once it is in the nose.
- Postoperatively DC-F grafts provide a smooth dorsum with significant augmentation, a natural contour, and well-defined dorsal lines.
- Complications with diced cartilage grafts tend to be relatively minor and confined to shape and visibility problems, not absorption.

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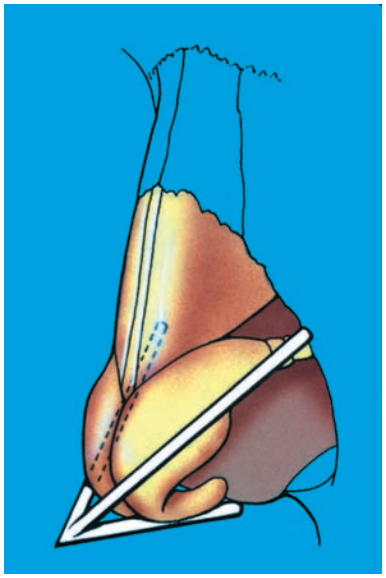
PART FOUR

The Tip



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Basic Nasal Tip Surgery: Anatomy and Technique

Jack P. Gunter ▪ Michael R. Lee ▪ Jamil Ahmad ▪ Rod J. Rohrich

To provide proper treatment of the nasal tip, the surgeon must have a comprehensive knowledge of relevant anatomy. Such anatomy provides the framework ultimately responsible for tip position and shape. Furthermore, understanding the role that different structures contribute to tip characteristics facilitates optimal diagnosis and treatment planning.

Pivotal to success in rhinoplasty is thorough analysis of both the face and nose. Disregarding facial analysis and focusing on the nose alone may lead to overall disharmony and an untoward result. Once the diagnosis has been established, the operative goals are determined. Proper execution of a successful treatment plan requires an understanding of the following:

1. Variations of the soft tissues and cartilage framework of the tip and their contributions to external appearance
2. Factors responsible for tip support and how they are interrelated
3. The result that each surgical maneuver or combination of maneuvers has on the overall surgical result

Surgery of the nasal tip requires a comprehensive knowledge of nasal anatomy and support.

In this chapter we will review the relevant anatomy of the nasal tip and operative strategies used to alter the position and shape of the nasal tip.

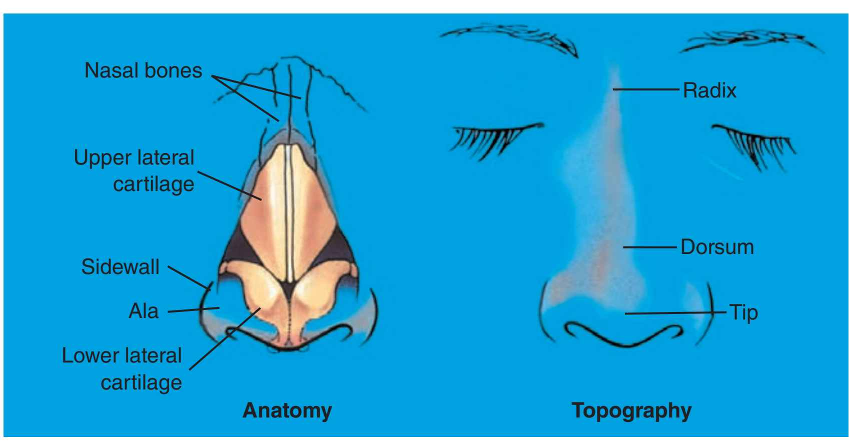
Treatment planning should be individualized for each patient. Communication with the patient is extremely important to identify any unrealistic expectations and to set more appropriate expectations that are commensurate with what can be achieved with rhinoplasty. Similar deformities of the nasal tip may require different modifications depending on the aesthetic relationship of the tip with the rest of the nose as well as the face. The use of a graduated approach in modifications of the nasal tip allows a safe and predictable approach.

When operating on the nasal tip it is best to follow a graduated approach with constant reassessment before each maneuver.

ANATOMY OF THE NASAL TIP SUPPORT STRUCTURES

Support for the nasal tip is derived from a combination of bony, cartilaginous, and soft tissue structures. Bone of the midface provides the foundation for nasal support. Medially, the maxillary crest serves as a buttress for the nasal septum. The septum in return provides crucial support for the external nose and nasal tip. Soft tissue attachments from the dorsal and caudal septum to the lower lateral cartilages have a direct influence on tip support and location. Laterally, soft tissue attachments connect the lower lateral cartilage complex to the bony piriform aperture.

To rotate the nasal tip, the surgeon must identify and remove anatomic structures resisting upward rotation.



Tip location is ultimately dependent on the position of the anterior septum and lower lateral cartilages.[1-3] There are both major and minor tip support structures.

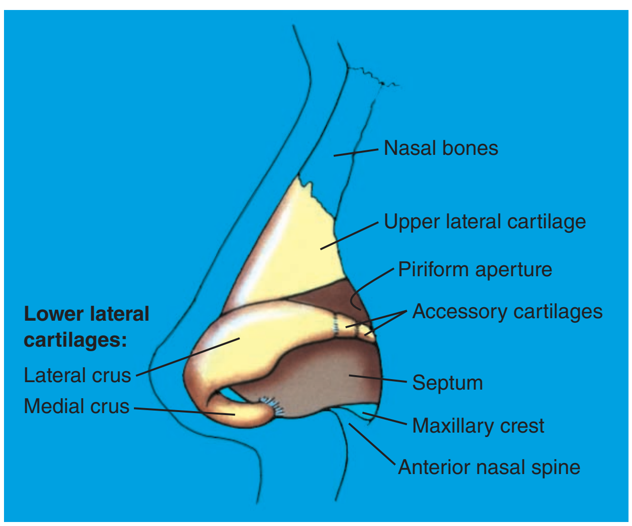
The paired lower lateral cartilages rely significantly on the dorsal and caudal septum for support. Lower lateral cartilage shape, position, and integrity are all important in terms of nasal tip appearance and functioning of the external nasal valves. Each lower lateral cartilage comprises a medial crus, a middle crus, and a lateral crus. The characteristics of these crura, along with soft tissue connections to adjacent structures, dictate the external appearance of the nasal tip.

Major and Minor Tip Support Structures

Major Tip Support Structures
- Fibrous connection of lateral crura to the upper lateral cartilages
- Abutment and attachment of the lateral crural complex to the piriform aperture
- Fibrous connection of the medial crura to the caudal septum and anterior nasal spine
- Suspensory ligament of the nasal tip

Minor Tip Support Structures
- Fibrous attachments of the lower lateral cartilages to the dorsal septum
- Lower lateral cartilage attachments to the skin
- Membranous septum

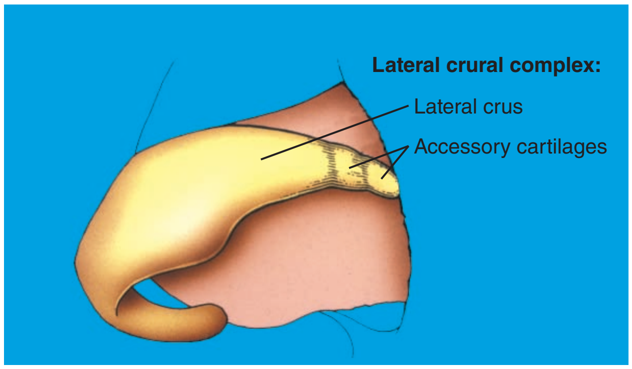
Lateral Crural Attachments to the Upper Lateral Cartilages



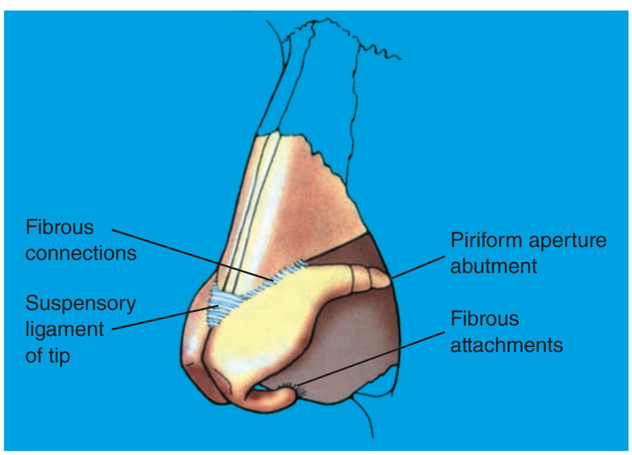
The upper lateral cartilages are secured cephalically by their connection to the nasal bones. Medially, the upper lateral cartilages abut and connect to the dorsal septum. Caudally, the upper lateral cartilages exhibit a soft tissue attachment to the cephalic border of the lateral crura at the scroll area. This connection provides support to the lateral crura and nasal tip.

Connective tissue fibers that attach the lateral crura to the upper lateral cartilages allow movement between the two structures while providing tip support. Violating the soft tissue connection between these two structures with an incision will obliterate this support as will cephalic trim of the lower lateral crura.

Lateral Crural Attachments to the Piriform Aperture



The lateral crura attach laterally to the piriform aperture by means of accessory cartilages. The accessory cartilages share continuous perichondrium, allowing them to function as a unit. Together the lateral crura, accessory cartilages, and associated soft tissue connections to the piriform aperture create the lateral crural complex. The soft tissue component of this area has been named the *piriform ligament,* underscoring its importance in nasal support. The lateral crural complex provides lateral support and rigidity for the nose.



Support of the lateral crural complex results from the suspensory ligament of the tip resting on the anterior septal angle, the fibrous connections to the upper lateral cartilages, and the abutment with the piriform aperture.

Anatomic variations of the lateral crural complex may have a direct impact on tip support and rotation. To elaborate, the rigidity of the connection between the lateral crus and accessory cartilages is directly related to the amount of tip support provided and resistance to posterior movement of the nasal tip. Also, if the abutment is high on the piriform aperture, there can be resistance to upward tip rotation.

Medial Crural Attachments to the Caudal Septum

The medial crura of each lower lateral cartilage approximate one another in the columella. Position, shape, and strength of the medial crura influence tip support and rotation. The medial crura approximate the caudal septum and anterior nasal spine with fibroelastic tissue attachments providing support but allowing mobility. Posterior movement of the medial crura is possible to some extent, since the caudal ends of each footplate flank the more midline septum and anterior nasal spine. Disruption of these soft tissue attachments, such as with a transfixion incision, allows greater posterior displacement of the medial crura and decreased tip projection. When the fibrous attachments from the medial crura to the caudal septum are violated, the only support remaining is that of soft tissue interposed between the footplates and nasal spine. This tissue is compressible, and the support it supplies is solely dependent on its density. Medial crural length also influences the support provided, because the closer the footplates are to the anterior nasal spine and premaxilla, the less soft tissue will be available for compression and the greater the resistance to posterior movement.

In addition, ample soft tissue, including collagen fibers, adipocytes, and muscle fibers of the depressor septi nasi and orbicularis oris muscles, is found between the opposing medial crura. Disruption of these soft tissues during open rhinoplasty will also influence tip projection.

Open rhinoplasty provides optimal exposure to the nasal framework. Such exposure allows comprehensive diagnosis and greater accuracy in surgical execution.

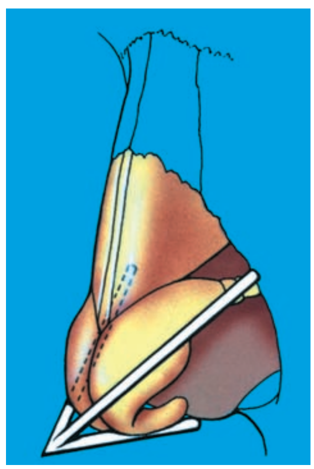
Suspensory Ligament of the Nasal Tip

Although some controversy exists regarding the nomenclature of the suspensory ligament of the nasal tip that is located in the interdomal region, its clinical relevance is not disputed. The ligament serves as a connection between the cephalic margins of the lateral crura as they diverge in the supratip region. The suspensory ligament rests over the anterior septal angle, in turn providing additional tip support. Clinically, when the dorsal septum is reduced or this ligament is violated, support is reduced.

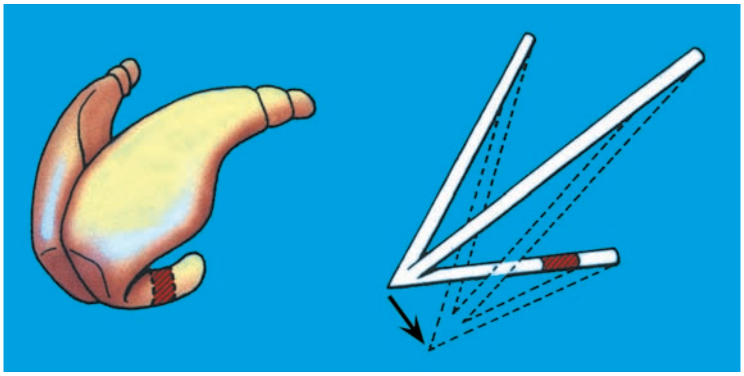
Fibrous attachments of the lower lateral cartilages to the upper lateral cartilages, piriform aperture, and caudal septum are responsible for nasal tip support and position.

Surgical maneuvers including transfixion incision, intercartilaginous incision, cephalic trim, and lower lateral cartilage division will violate support structures and change the position of these cartilages. Minor contributions to nasal tip support include the fibrous attachments of the lower lateral cartilages to the dorsal septum, the membranous septum, and lower lateral cartilage attachments to the overlying skin. The skin of the nose adheres to the tip cartilages, stabilizing the tip and resisting movement of the tip cartilages. Freeing the skin from the cartilages eliminates this resistance. The overlying skin may play a more vital role in tip support than previously thought.

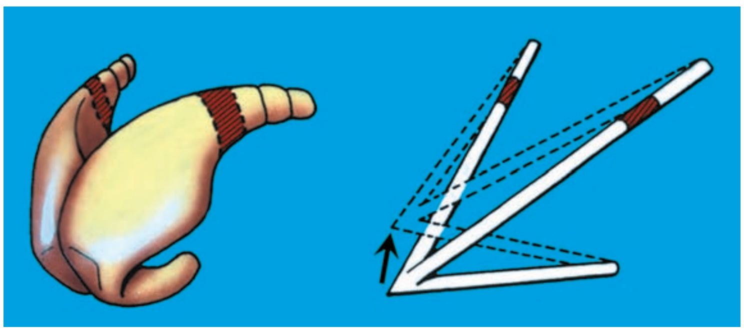
THE TRIPOD CONCEPT



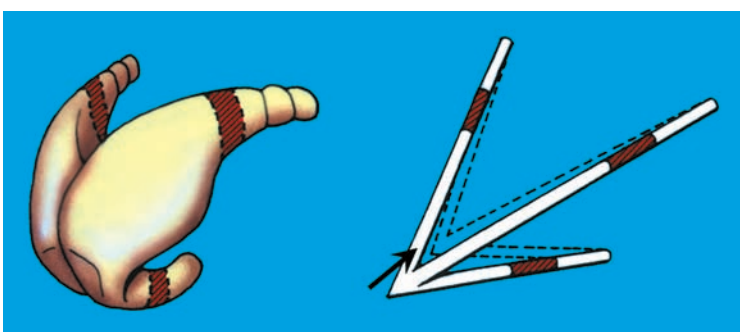
The tripod concept proposed by Anderson remains a useful means of understanding the relationship between tip rotation and projection.[4,5] With the patient upright, the tripod lies on its side, with one lower leg and two upper legs. The lateral crura represent two upper lateral legs, and the abutting medial crura produce the central lower leg. The lower tripod leg is also influenced by the caudal septum. Shortening the medial crura or violating the related soft tissue support, as mentioned previously, leads to a decrease in nasal tip projection and rotation. Shortening of the upper legs or violation of associated soft tissue leads to decreased projection and increased rotation. Augmentation with grafts or struts that alter tripod leg length will also influence tip position.



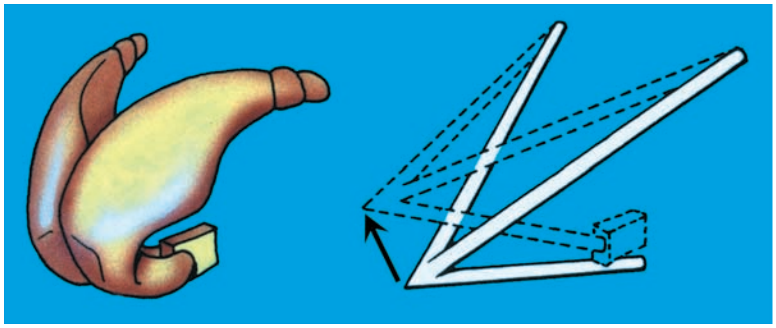
Shortening (or violating support) of the lower leg leads to decreased projection and rotation.



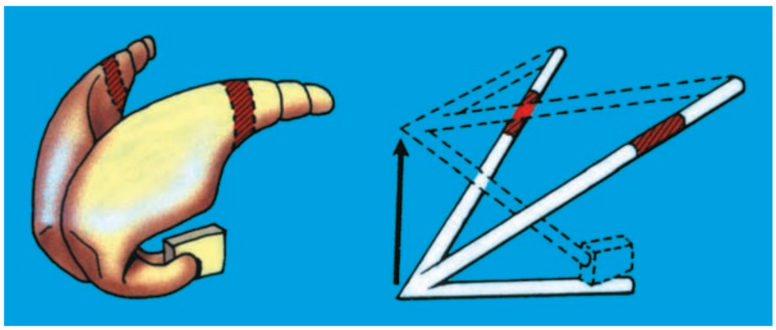
Shortening of the upper tripod legs will result in decreased projection and increased rotation.



Shortening of all three tripod legs will result in decreased projection, with minimal influence on tip rotation.



Lengthening the lower tripod leg should result in increased tip projection and rotation.



Lengthening the upper tripod legs and shortening the lower leg should accentuate upward tip rotation.

The tripod concept facilitates an understanding of how surgical modifications to the medial and lateral crura influence tip position.

Although the tripod concept provides a foundation for understanding surgery of the nasal tip, it is apparent that subtleties in tip dynamics preclude total reliability. The tripod concept provides a basis for diagnosing abnormalities and guiding surgical planning.

MODIFICATIONS OF THE TIP CARTILAGES

Modified tip cartilages are commonly used for the following purposes[6]:

1. To alter tip projection
2. To alter tip rotation
3. To improve tip definition
4. To reduce tip fullness
5. To create a supratip break
6. To improve the alar-columellar relationship

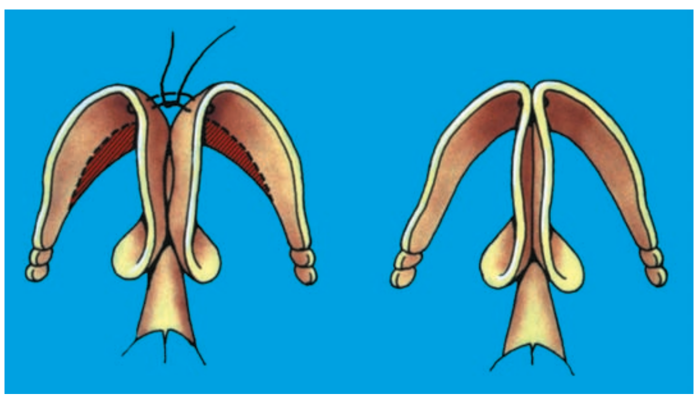
Many techniques to achieve such goals have been described, including the following:

- Cephalic trim of the lateral crura
- Suture reshaping of the cartilages
- Suture repositioning of the cartilages
- Vertical transection and overlapping of the lateral crura
- Vertical transection and overlapping of the medial crura
- Excision of the medial crura caudal margins
- Resection of the caudal septum
- Placement of tip graft(s)
- Placement of a columellar strut graft
- Placement of lateral crural strut grafts
- Placement of alar spreader graft(s)
- Placement of extended alar contour graft(s)

Altering Tip Projection

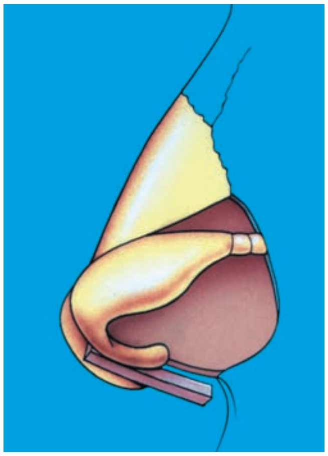
Increasing Tip Projection

Increasing projection of the nasal tip can prove quite challenging.[7-10]

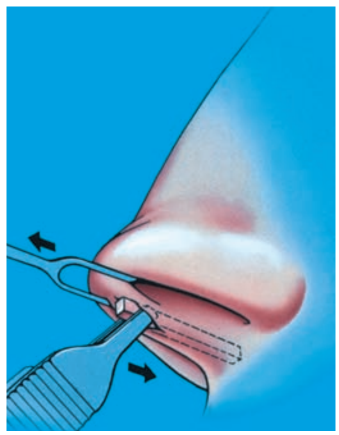


When there is moderate flaring of the medial crura as they transcend the dome area, suturing the medial aspect of the domes together can provide a slight increase in tip projection. Thus suturing straightens the flare of the anterior medial and middle crura.

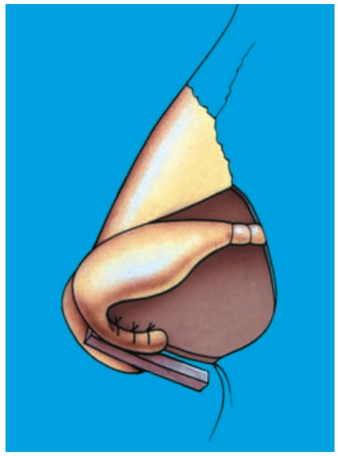
Suturing flared medial crura together provides a small increase in nasal tip projection.



Placement of a columellar strut graft may provide some increase in nasal tip projection.[6,11-12] This is particularly true when using a fixed strut and less so when using a floating strut. The increase in projection is relative to strut size and is influenced by skin envelope characteristics. If the columellar strut is insufficient to expand the nasal tip or the skin envelope restricts projection, there will be little or no increase in tip movement. In this case, columellar strut graft placement helps to maintain tip projection and is used to unify the tip to allow tip reshaping.



The amount of tip projection achieved with columellar strut graft placement also varies depending on the surgical approach. With the closed approach, a minimal increase in tip projection can be accomplished. In a closed approach the strut is placed through a vertical incision at the base of the columella. A pocket is created between the medial crura to the level of the anterior nasal spine. A soft tissue interface is preserved on the anterior nasal spine to prevent direct abutment of the strut on the ridge inferior to the anterior nasal spine. Contact at this area can lead to clicking or lateral displacement of the strut. Placement of the columellar strut graft into the pocket is accomplished by passing it through the vertical incision while using a double-pronged skin hook secured in each vestibular apex to maintain the tip in the desired position. Use of a Brown-Adson forceps allows pushing the strut first toward the pocket base and then into its anterior position. Pocket size should extend 1 to 2 mm beyond the anterior end of the incision to allow projection of the strut past the incision edge.



Columellar strut placement using an open approach allows a greater increase in tip projection, given the ability to release the lower lateral cartilages and reestablish them in a more projecting position on the strut. Following elevation of the nasal skin envelope, a pocket is created between the feet of the medial crura. Again, a soft tissue layer is preserved on the premaxilla to avoid having the strut seated directly on nasal spine bone. The columellar strut can be placed in an invisible position by dissecting the pocket closer to the caudal septum superiorly. If changes in the shape of the columella, alteration of the alar-columellar relationship, and/or columellar-labial transition are desired, this pocket can be dissected closer to the columellar skin.

If changes in the shape of the columella, alteration of the alar-columellar relationship, and/or columellar-labial transition are desired, this pocket can be dissected closer to the columellar skin.

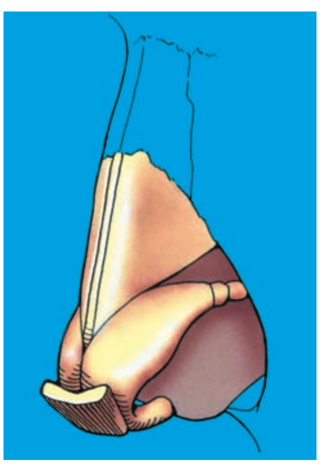
The columellar strut is placed into the pocket with Brown-Adson forceps and pushed toward the anterior nasal spine to ensure that it is resting in the bottom of the pocket. Double-pronged skin hooks secured in each vestibular apex are used to maintain the tip in the desired position during placement of the medial crural–columellar strut sutures. A 30-gauge needle can be used to align the strut during suturing by placing it through the medial crus and columellar strut, then through the opposite medial crus.

Open approach placement of a columellar strut provides superior control and a greater increase in tip projection.

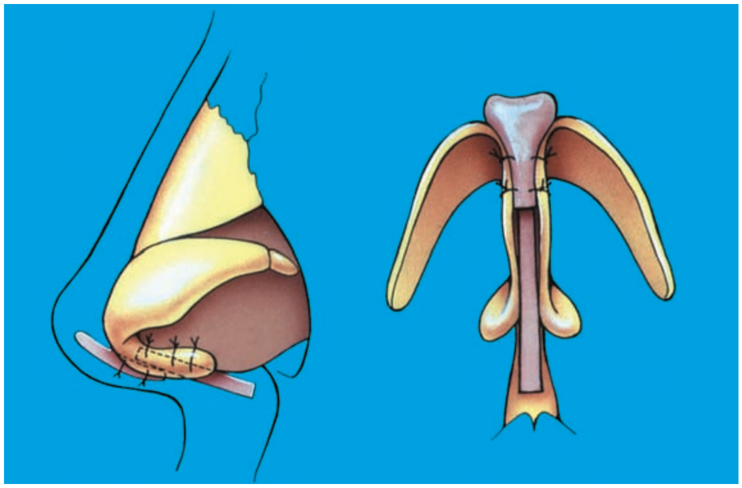
When additional strength and rigidity are needed for the columellar strut graft, a 5 mm wide and 25 mm long piece of harvested septal cartilage is required. A midline longitudinal partial-thickness incision is created on one side of the cartilage. The cartilage is then folded on itself toward the intact side. The cartilage will bend and break, but the intact surface serves as a hinge keeping the two pieces together. This makes the strut easier to handle and obviates the need to suture the two pieces together. However, this two-layered columellar strut may result in an excessively wide columella.

If additional tip projection is required, the lateral crura may be advanced medially. This maneuver is termed the *lateral crural steal* and is performed with horizontal mattress sutures, resulting in the creation of new tip-defining points on each lateral crus. Suture placement is performed so that the medial vertical segment of the suture lies on the same vertical plane as the original tip-defining point. The lateral vertical segment of the suture then lies 3 to 4 mm lateral to the tip-defining point. The suture knot lies medially. Adson-Brown forceps are used to crimp the cartilage halfway between the vertical suture segments. The suture is tightened and tied to secure the position of the manipulated cartilage. Suturing of the medial surfaces to the columellar strut stabilizes the tip. Finally, the anteriormost aspect of the columellar strut is cut flush with the tip-defining points. Lateral crural steal is easier when the convexity of the domes is a gentle curve and is not more acutely angulated.

Lateral crural steal involves advancing the lateral crura medially and using horizontal mattress sutures to create new tip-defining points on each lateral crus.



If additional projection is needed, a shield-shaped tip graft is used. The original Sheen description used a flat shield-shaped graft from septal cartilage with one end notched in the center.[13-20] The blunted cartilage remained 6 to 8 mm apart to create the two tip-defining points. Graft length varied, depending on the projection needed, but on average was 10 to 12 mm. Graft placement using the closed approach occurred through an infracartilaginous incision extending along the caudal rim of the medial crura to the anterior columella.

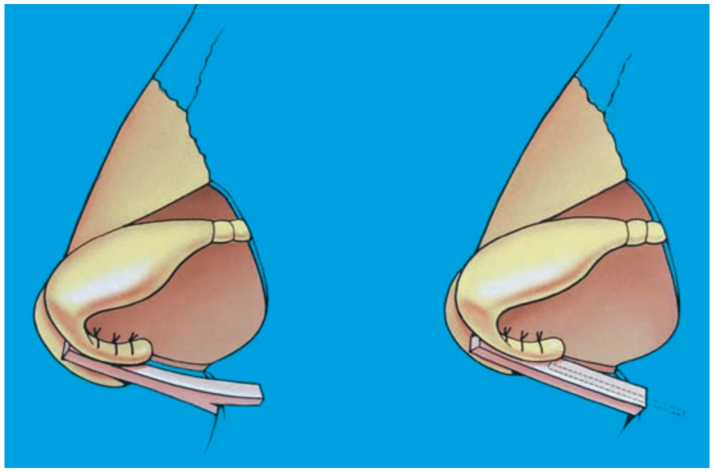


Placement of the shield graft through the open approach was popularized by Johnson and Wyatt[21] and allowed a more accurate fixation. The degree of tip projection required determines graft thickness and possible placement of multiple stacked grafts.

Over time the tip graft can become visible, with thinning of the overlying skin, distortion of the graft, or displacement of the graft. Visibility is primarily a problem when graft edges are appreciated through the skin. To circumvent such outcomes, using blended tip grafts such as anatomic cap grafts from the cartilage removed during cephalic trim or morselized septal cartilage can alter tip shape while having imperceptible edges. Additionally, meticulous carving of the graft edges is important. Also, using cartilage pieces or additional grafts in a stacking manner to obviate dead space behind the graft will create a more camouflaged tip if the skin thins.

A graduated approach to increasing tip projection includes placement of a columellar strut graft, followed by lateral crural steal with fixation to the strut, and if necessary, tip grafting may also be used to achieve greater tip projection.

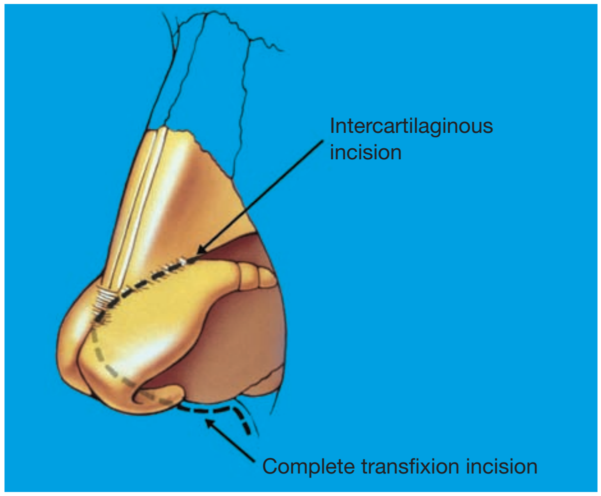
Septal extension grafts may also be used to increase tip projection.[22,23] Various types of septal extension grafts exist (see Chapter 23).



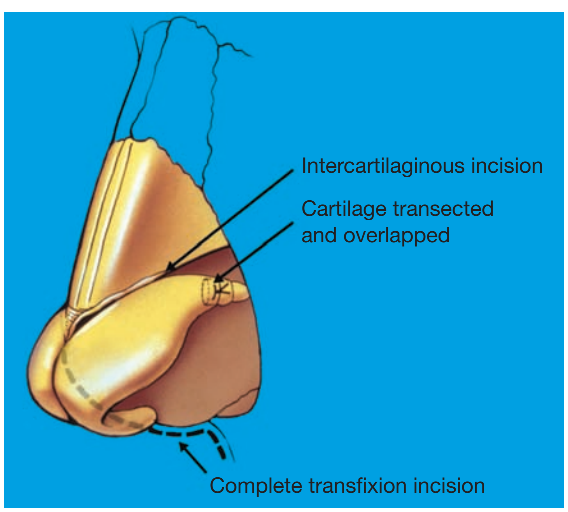
When the increase in tip projection exceeds 4 mm, autologous rib is used for strut fabrication. Rib cartilage is inherently rigid and can be harvested to any required length. Initially, columellar struts were carved with a notch on one end. This end was then placed so that the notch seated directly on the anterior nasal spine. Tip projection of 6 to 7 mm could be gained with this method, but the strut placed in this plane led to significant widening of the columella and was subject to warping forces. Evolution of the technique led to the use of a 0.035-inch threaded K-wire placed through the strut with one end fixed to the premaxilla. Although use of the K-wire evaded warping, it was not without complications. Some authors reported that wires became infected and/or suffered extrusion. Because of these problems, K-wires are not commonly used in the columella today.

Carving balanced cross-sections of cartilage should be practiced when creating struts from rib cartilage to minimize warping. Furthermore, these long columellar struts can be used with extended spreader grafts for additional support and tip projection. Problems with the use of large columellar strut grafts include excessive widening of the columella and limited mobility of the nasal tip. Such factors must be considered when using a columellar strut graft.

Decreasing Tip Projection

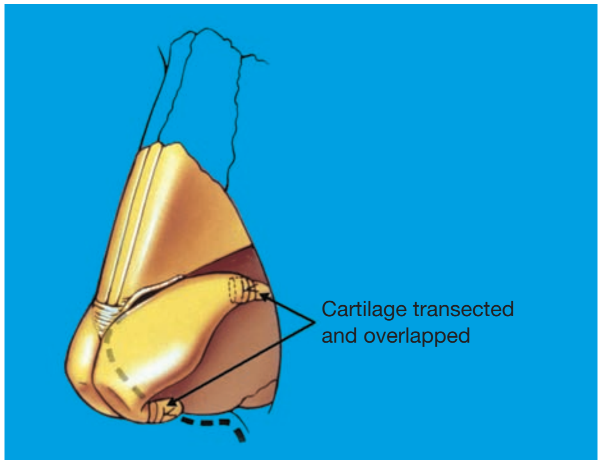


Decreasing nasal tip projection is accomplished by weakening or eliminating the elements that support the tip.[24] Several of these supports are violated with routinely used surgical incisions. A complete transfixion incision violates the fibroelastic connections between the medial crura and caudal septum. This allows greater posterior migration of the medial crural footplates toward the anterior nasal spine. The shorter the medial crura and the less soft tissue present that prevents posterior motion, the more the tip will deproject. Placement of an intercartilaginous incision, release of the lateral crura from the upper lateral cartilages at the scroll area, or cephalic trim of the lower lateral cartilage violates the fibrous attachments suspending the lateral crura from the upper lateral cartilages and decreases tip support. Additionally, division of the suspensory ligament that spans the domes will weaken tip support.



Lateral crura complex strength and stability play a pivotal role in tip support and should be considered when decreasing tip projection. A lateral crural complex that is strong and firmly adherent to the piriform aperture resists posterior movement of the tip.[25-27] Resistance may be reduced or eliminated by undermining the vestibular skin from the deep surface of the lateral crural complex and vertically transecting the cartilages to allow overlapping and posterior movement. Suture fixation is used to secure the region of overlap and reestablish support of the lateral alar wall.

In some cases, a lateral crural strut graft may be required for adequate support after transection and overlap of the lateral crus.[28]



Vertical transection with overlap and suture fixation of the medial crura may also be performed.[29] This maneuver is employed when the medial crura are elongated and resist posterior movement of the tip. Transection is typically completed midway between the tip-defining points and the columellar-lobular angle following vestibular skin undermining. Any folding of the vestibular skin is concealed by the skin of the soft tissue triangle.

Decreasing tip projection should follow a graduated approach. Disruption of soft tissue support is performed with reassessment of tip position. If greater deprojection is needed vertical transection of the lateral and/or medial crura with cartilage overlap allows posterior displacement of the tip and may be required.

Deprojecting the nasal tip may produce flaring of the alae. In a long, narrow nose this may improve overall nasal aesthetics, but noses with normal or preexisting alar flaring require assessment and possibly surgical intervention to correct. Flaring results from alar rim skin and lateral crural complex rigidity that resists compression. Treatment for the lateral crural complex, as discussed earlier, is with vertical transection, whereas alar skin excess is treated with alar base excision.

Decreasing tip projection can be accomplished incrementally by elevation of skin envelope, violation of tip-supporting fibrous attachments, addressing the dorsal septum, and then transection and overlap of lateral and/or medial crura.

Alar flaring does not always result from decreasing tip projection. Occasionally, the overprojected nose is associated with the appearance of the alar base being pulled away from the underlying face and skeleton. Such a finding is usually seen in those patients with a class II skeletofacial deformity and a high septal angle producing a tension tip nose. In these patients, lowering the tip allows the base to settle back into the appropriate location and does not exhibit flaring on the ala until a point is reached where settling is complete and flaring begins.

Bowing of the columella in a downward direction may also occur when the nasal base meets resistance from the maxilla. Such movement can result in increased infratip lobular show and/or increased columellar show. Correction requires transection, overlapping, and suture fixation of the medial or middle crura and/or resection of the membranous columella with a small portion of caudal septum, allowing wound closure and pulling of the columella cephalad.

The relationship between nasal projection and the alar base is crucial to understand. In cases where alar base resection is performed due to a wide lower third, tip projection can be effected. To further explain, the absolute tip position is not altered but the alar-cheek junction is advanced toward the tip giving an appearance of decreased projection.

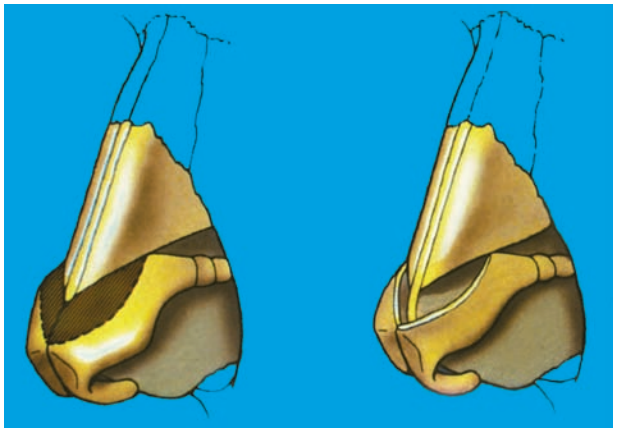
Altering Tip Rotation

The tripod concept also applies to altering of tip rotation. Moreover, understanding the anatomic structures that support the nasal tip is important as such structures may limit tip rotation.

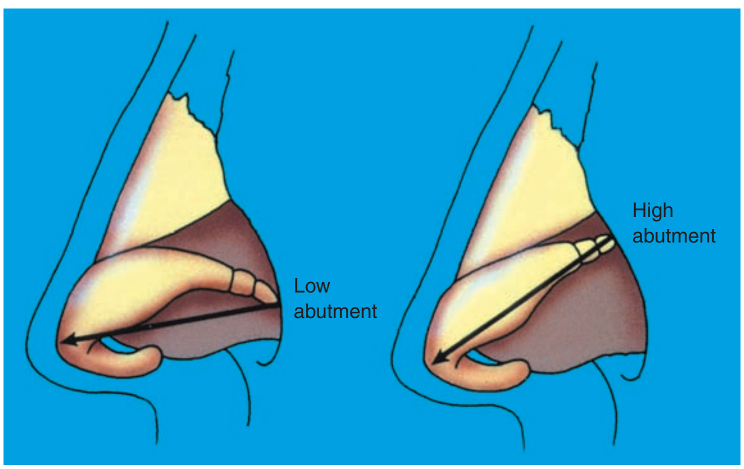
Factors that resist upward rotation of the nasal tip include the following:

- Fibrous attachments connecting the lateral crura to upper lateral cartilage
- A cephalic abutment of the lateral crural complex against the piriform aperture
- A prominent caudal septum
- Lengthy upper lateral cartilages
- High septal angle
- Skin adherence to the lateral crura, upper lateral cartilages, and nasal bones

Increasing rotation of the nasal tip requires evaluation of each factor that may limit upward rotation. The result of such assessment guides surgical decision-making.



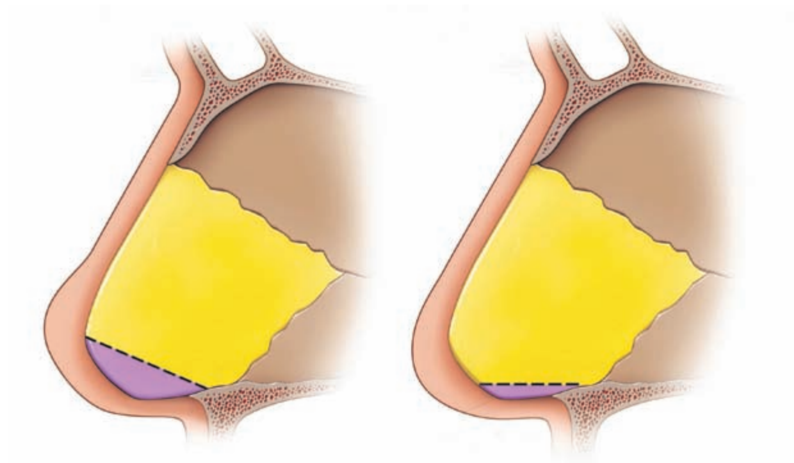
Either placement of an intercartilaginous incision or resection of the cephalic lateral crura eliminates resistance from the fibrous attachments connecting the lateral crura to upper lateral cartilages. If rotation is desired, a portion of the cephalic margin of the lateral crura is resected. Following resection, the lateral crura are typically free to be moved upward.



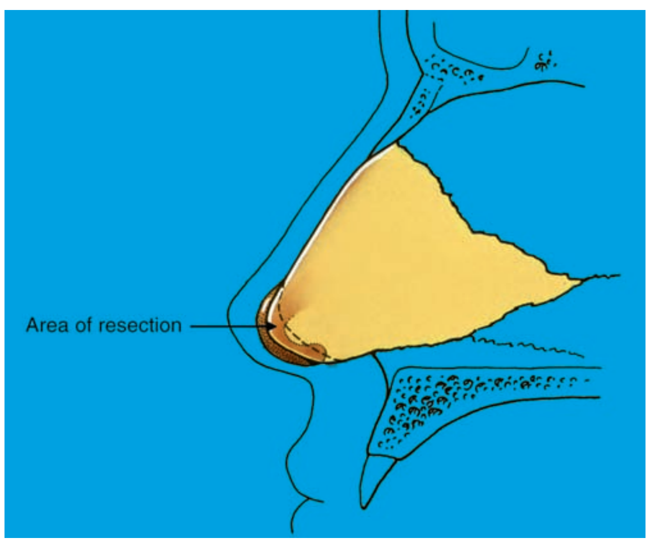
If the lateral crural complex abuts the piriform in a more cephalic direction, it will prevent upward tip rotation. Elimination of this force is as previously described, with vertical transection of the cartilage and overlap with suture fixation. Placement of a columellar strut is occasionally needed to maintain tip rotation and avoid posterior movement of the medial crura.

If rotation of the tip is still limited after these maneuvers, the caudal septum should be assessed as it may interfere with upward movement of the medial crura. Loose connective tissue between the medial crura feet and caudal septum typically allow rotational movement. When greater rotation is needed these connections may cause tethering and need to be released usually with caudal septal

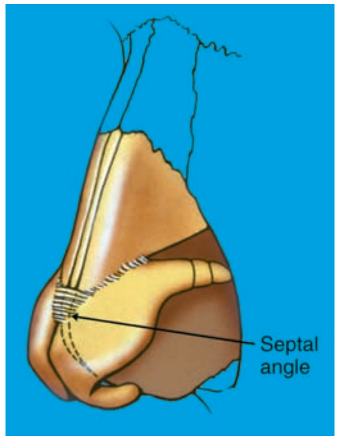
resection. Elongated upper lateral cartilages are typically addressed during cephalic resection of the lateral crura. It is important to reconstruct the dorsum appropriately so that midvault collapse is avoided.



Determining which portion of the septum should be resected depends on the columellar-labial angle.



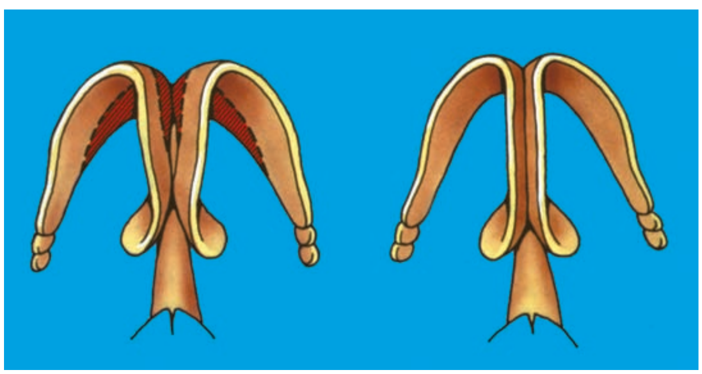
If the angle is normal then resection should be isolated to the anterior portion of the caudal septum. When the angle is displaced down and out, more cartilage is resected from the posterior caudal septum and adjacent to the anterior nasal spine. This type of problem is seen more commonly in patients with class II skeletofacial deformities with short upper lips. Resection to any significant degree of the caudal septum is typically accompanied by similar resection of membranous septum.



Presence of a high septal angle may resist upward rotation of the nasal tip if the suspensory ligament remains intact. Either lowering of the septal angle or dividing the suspensory ligament will address this. Skin adherent to the underlying cartilage can also obstruct upward tip rotation. To correct such a problem, the skin should be undermined and redraped after cartilage movement.

A more challenging problem is derotation of the tip combined with lengthening the nose. This is covered in Chapters 25 and 49.

Improving Tip Definition

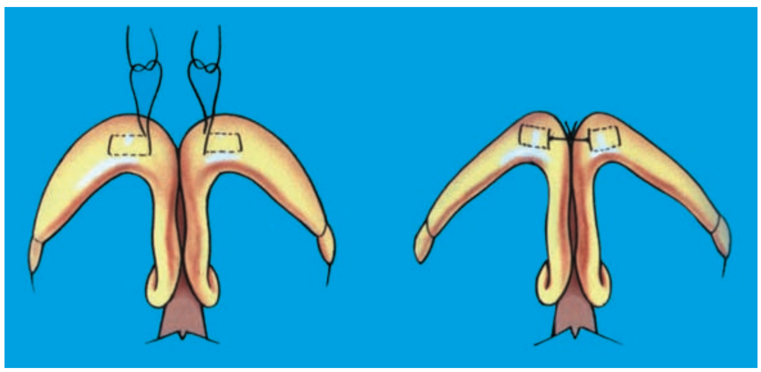


Decreasing the width between tip-defining points can be best accomplished with interdomal suture placement to closer approximate the domes.[30-40] An additional method to accomplish this task is through cephalic trim of the lateral and middle crura of the domes. Typically, as the lower lateral cartilages transition from dome to columella, they flare so that the caudal margins are separated. Resection of the cephalic margins improves alignment and allows the tip-defining points to shift medially.

Narrowing the angle of divergence and medializing the tip-defining points is accomplished by tip suture techniques and/or by cephalic trim of the lower lateral cartilages.

Reducing Tip Fullness

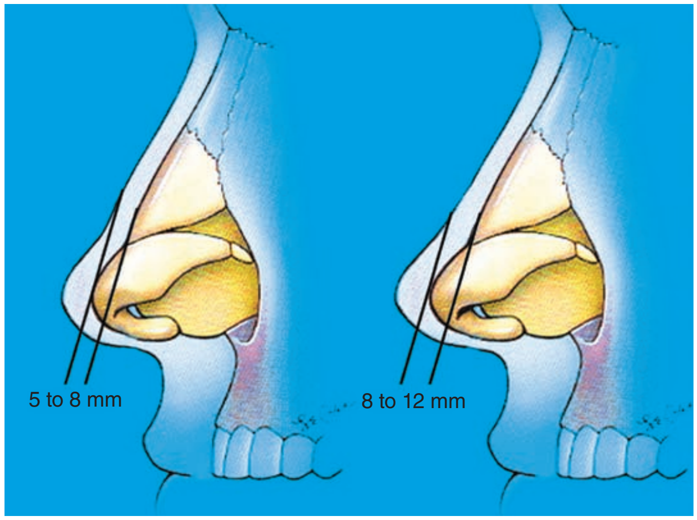
Fullness of the nasal tip is seen rather frequently and requires partial cartilage resection, weakening of the lateral crura, or suture reshaping of the lateral crura.[30-40] Cephalic trim of the lower lateral cartilages will reduce tip fullness while the remaining caudal segment continues to flare, resulting in a bulbous-appearing nose.



To reduce this caudal lateral crura flare, a horizontal mattress suture is placed in the dome area. Angulation of the dome is increased with tightening and tying of the suture. Suture placement is completed bilaterally with one suture being left long and eventually tied to the contralateral suture then tightened to the desired level, acting as an interdomal suture. When fullness is the result of severe lateral crura convexity, lateral crural strut grafts are the preferred method used to straighten the lateral crura. Lower lateral crural turnover flaps may also be used to correct shape while decreasing tip fullness. Both of these techniques are discussed in Chapters 28 and 29.

Reducing fullness in the nasal tip is accomplished by cephalic trim of the lower lateral cartilages, suturing of the domes to increase angulation, and by placement of lateral crura strut grafts to correct severe convexity and correct crura position.

Creating a Supratip Break



Formation of a supratip break is frequently desired in females. Supratip break exists when the nasal tip is higher than the dorsum. Creation of a supratip break is accomplished through creating tip-defining points with good projection and reducing the dorsum to the desired effect. Long lasting tip support must also be established or the tip will settle and the break will be lost. In some cases, failure to provide adequate support to the nasal tip will result in loss of projection and derotation and a pollybeak deformity. Skin of the supratip region is thicker than the actual tip and this must be accounted for when determining the final septal height. Placement of the septal angle is usually 5 to 8 mm lower than the tip-defining points with thin to medium thickness skin, while this may need to be 8 to 12 mm with thick skin.

Patients with thick skin, which blunts the supratip break or limits tip definition, may require debulking of tip soft tissue. Loose connective tissue on the undersurface of the skin envelope may be removed with forceps. Removal should be limited to soft tissue loosely attached to avoid dermal injury and external dimpling. In the case where the musculoaponeurotic layer is thick, this can be carefully excised, avoiding subdermal defatting, which can lead to scarring and even compromise of the skin circulation. Use of an absorbable suture can be used to attach the skin to the cartilage at the supratip and can help to obliterate dead space.

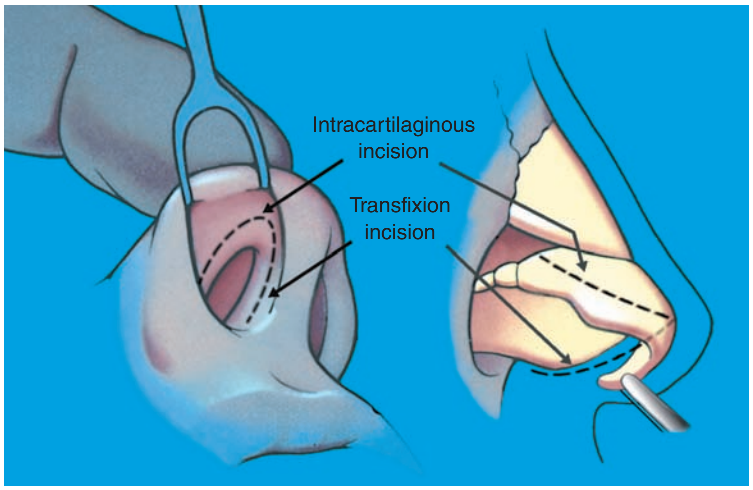
Creating supratip break places the tip-defining points 5 to 12 mm above the septal angle; varying on skin thickness differences between the dorsum and tip.

Improving the Alar-Columellar Relationship

Medial crura aberrations in shape and position disrupt nasal harmony between the columella and alar rims. Correcting this problem usually requires cartilage modification in the shape or position of the medial crura, tissue excision, or cartilage grafting. This is described in detail in Chapter 26.

SURGICAL APPROACHES TO THE TIP CARTILAGES

Cartilage-Splitting Technique



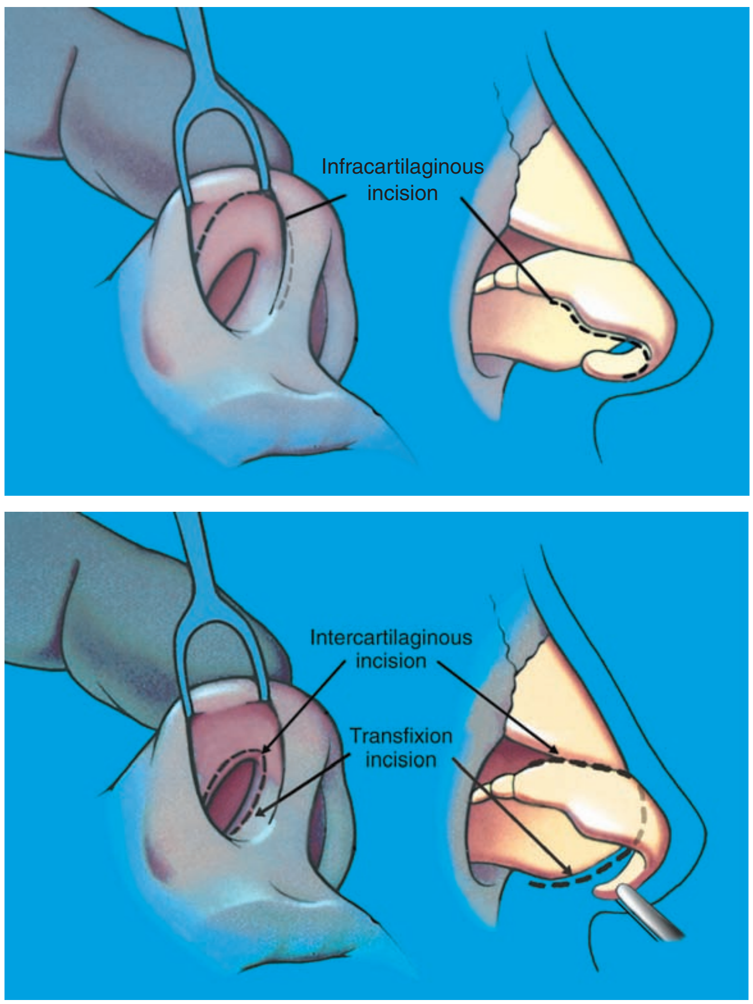
Use of the intracartilaginous incision is performed when the only modification needed is removal of lateral crura cephalic margins and/or anterior medial crura cephalic margins. The goal is to decrease tip bulbosity in the presence of normal or near normal intercrural distance. Surgical objective is to improve tip definition and create a supratip break.

The incision begins with placement of a double-pronged skin hook inside the alar rim with the medial hook just medial to the nostril apex. The incision is connected to the anterior portion of a partial or complete transfixion incision. With the hook used to lift the skin, the lateral crus is pressed toward the vestibular opening with the fourth finger, forcing the cartilage caudal margin and body into prominence. The surgeon estimates the desired caudal segment width to leave and visually marks that distance from the caudal edge of the cartilage to determine incision placement.

The incision is made medial to lateral beginning at the anterior end of the transfixion incision. The incision curves upward as the incision moves laterally to remain parallel with the cartilage edge. The incision can be created through the

vestibular skin only with skin elevated off of the cartilage to its junction with the upper lateral cartilage. In this manner, the amount of exposed cartilage can be compared bilaterally to help determine the amount to excise. The cartilage is transected at the same level on each side, with the cephalic segment separated from the overlying soft tissue and removed. The initial incision can also be made through both skin and cartilage simultaneously. The disadvantages of this incision are the technical challenges associated with symmetric cartilage harvest and the limited ability to modify remaining cartilage. The disadvantage of this approach is that the cartilages are not directly visualized and the amount of remaining cartilage can only be assumed.

Cartilage Delivery Technique



The cartilage delivery technique includes use of an infracartilaginous incision that joins a partial or complete transfixion incision. The infracartilaginous inci-

sion is made by incising vestibular skin along the caudal margin of the lateral crura. The incision begins laterally just beyond the location where the caudal rim of the lateral crus diverges from the alar rim to move cephalad. It continues medially, following the caudal rim of the lateral crus and medial crus, finally ending at the columellar-lobular junction. The incision may be extended further on both ends to facilitate cartilage delivery.

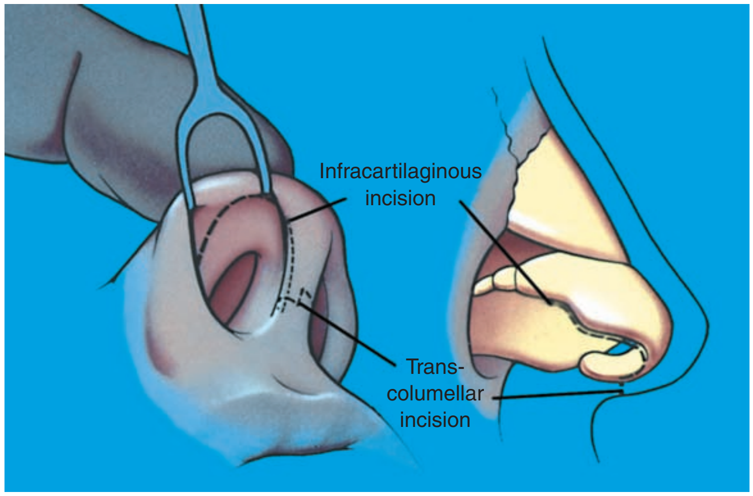
An intercartilaginous incision is created beginning at the lateral end of the limen vestibuli and extends medially 2 mm caudal and parallel. The incision is then curved into the membranous septum anterior to the valve region where it meets the transfixion incision. Skin is then separated from the cartilage starting at the infracartilaginous incision, ceasing at the lateral and medial extensions of the incisions. Such undermining connects the intercartilaginous and infracartilaginous incisions, while creating a bipedicled flap of cartilage lined with vestibular skin. It is then delivered from the nostril to expose the superficial surface of the cartilages.

On delivery, the cartilage is often distorted as the ends are tethered. A right-angle hook placed in the apex can help more accurately identify the dome area after delivery. With the hook secured the cartilage is pulled out the nostril and the dome marked. With difficult delivery, the incisions are extended as needed and soft tissue undermined to improve access. Following adequate delivery and marking of the domes, cartilage modification is performed.

The cartilage delivery technique permits direct exposure of the lower lateral cartilages, providing greater flexibility compared with cartilage-splitting technique. The foremost disadvantage of the cartilage delivery technique is the associated distortion of delivered cartilage making it difficult to conceptualize the final cartilage shape once returned deep to the skin. Placing the cartilage back into the appropriate location and suturing the caudal rim back into original position is problematic if crosshatching is not used for alignment. Inaccurate incisions and suturing may result in alar rim notching and obliteration of soft tissue facets.

Distortion of the delivered cartilage is the primary disadvantage with the cartilage delivery technique.

The Open Approach



Opening the nose uses a transcolumellar incision connected to bilateral infracartilaginous incisions to elevate the nasal skin envelope.[41,42] Soft tissue is elevated from nasal cartilage and bone, exposing the complete tip and majority of the dorsum. The transcolumellar incision may be designed as in inverted-V or stairstep pattern. The flanking infracartilaginous incisions are designed and completed in the same method described for the cartilage delivery technique. The incisions cease medially where the medial crura footplates begin to flare.

The open approach allows comprehensive diagnosis of existing deformity and optimizes surgical intervention as a result of maximal exposure. Inspection of the cartilages in their natural anatomic position and determining the subsequent influence on tip appearance is more easily accomplished through the open approach.

Advantage of the open approach is optimal visualization of the undisturbed nasal infrastructure providing a more accurate diagnosis and treatment.

Furthermore, it is easier to observe the influence that each maneuver has on the overall cartilaginous framework. The final modified framework can be acurately assessed before the conclusion of surgery. The skin envelope is redraped and the entire nose is once again inspected and palpated to ensure the desired result. Lifting the skin envelope and making the appropriate changes can easily address any irregularities.

Additional advantages of the open approach include the following:

- Enhanced ability to use both hands
- Improved control of bleeding limiting postoperative edema
- Greater ease of contouring and suturing existing structures
- More accurate placement and fixation of grafts
- Optimal for teaching rhinoplasty

Open approach rhinoplasty has enjoyed great popularity because of the optimal exposure for diagnosis and surgical intervention. It is extremely useful in patients with unusual deformities of the nasal tip, for secondary rhinoplasty or posttraumatic noses, and for nasal deformities associated with cleft lip.

Disadvantages to the open approach include the transcolumellar scar and potential for greater postsurgical edema. A closed approach with broad undermining would produce similar edema. The incision should be placed at the narrowest portion of the columella, typically where the medial crura begin to flare. Straight line incisions are avoided to prevent scar contracture and notching of the scar at the transition from the external to internal columellar skin. Instead, an inverted-V or stairstep pattern is recommended. With accurate closure, a fine, narrow scar is produced on the undersurface of the nose that is imperceptible. Critics of open rhinoplasty have reported prolonged tip edema, extended operating time, and an inability to create small graft pockets.

KEY POINTS

- Surgery of the nasal tip requires a comprehensive knowledge of nasal anatomy and support.
- When operating on the nasal tip it is best to follow a graduated approach with constant reassessment before each maneuver.
- To rotate the nasal tip, the surgeon must identify and remove anatomic structures resisting upward rotation.
- Open rhinoplasty provides optimal exposure to the nasal framework. Such exposure allows comprehensive diagnosis and greater accuracy in surgical execution.
- Fibrous attachments of the lower lateral cartilages to the upper lateral cartilages, piriform aperture, and caudal septum are responsible for nasal tip support and position.
- The tripod concept facilitates an understanding of how surgical modifications to the medial and lateral crura influence tip position.
- Suturing flared medial crura together provides a small increase in nasal tip projection.

- If changes in the shape of the columella, alteration of the alar-columellar relationship, and/or columellar-labial transition are desired, this pocket can be dissected closer to the columellar skin.
- Open approach placement of a columellar strut provides superior control and a greater increase in tip projection.
- Lateral crural steal involves advancing the lateral crura medially and using horizontal mattress sutures to create new tip-defining points on each lateral crus.
- A graduated approach to increasing tip projection includes placement of a columellar strut graft, followed by lateral crural steal with fixation to the strut, and if necessary, tip grafting may also be used to achieve greater tip projection.
- Decreasing tip projection should follow a graduated approach. Disruption of soft tissue support is performed with reassessment of tip position. If greater deprojection is needed vertical transection of the lateral and/or medial crura with cartilage overlap allows posterior displacement of the tip and may be required.
- Decreasing tip projection can be accomplished incrementally by elevation of skin envelope, violation of tip supporting fibrous attachments, addressing the dorsal septum, and then transection and overlap of lateral and/or medial crura.
- Increasing rotation of the nasal tip requires evaluation of each factor that may limit upward rotation. The result of such assessment guides surgical decision making.
- Narrowing the angle of divergence and medializing the tip-defining points is accomplished by tip suture techniques and/or by cephalic trim of the lower lateral cartilages.
- Reducing fullness in the nasal tip is accomplished by cephalic trim of the lower lateral cartilages, suturing of the domes to increase angulation, and by placement of lateral crura strut grafts to correct severe convexity and correct crura position.
- Creating supratip break places the tip-defining points 5 to 12 mm above the septal angle; varying on skin thickness differences between the dorsum and tip.
- Distortion of the delivered cartilage is the primary disadvantage with the cartilage delivery technique.
- Advantage of the open approach is optimal visualization of the undisturbed nasal infrastructure providing a more accurate diagnosis and treatment.

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18

Advanced Suture Techniques

Ronald P. Gruber ▪ Aaron J. Berger ▪ Edwin Kwon

Rhinoplasty is considered by most to be the most difficult of all aesthetic plastic procedures. For many years the nasal tip was considered to be the most complex part of rhinoplasty. The broad, bulbous, round nasal tip was treated with much cartilage resection, scoring, and bruising, all in an attempt to reduce its size and bring about a normal shape. Unfortunately, postoperatively, very few nasal tips were of very high quality. It was eventually recognized that destructive techniques simply were not working and that remodeling and remolding with sutures would be the best way to achieve controllable and replicable results.

BACKGROUND

Suture techniques to control the cartilages of the nose and therefore nasal shape originated with Jacques Joseph in the 1930s. He developed the basis of today's columellar-septal suture when he used sutures to secure the tip complex to the septum. Modern techniques began in large part with Tardy et al,[1] who applied a transdomal suture to control dome width in the closed approach. In the 1980s Daniel[2] introduced his domal definition suture in the open approach. This was followed by a flurry of suture techniques, which became part of the rhinoplasty evolution and continue to be developed today. Guyuron and Behmand[3] provided a review of commonly employed suture techniques. A significant number of surgeons have contributed enormously to this field.[4-21] Our personal experience led us to favor the suture techniques discussed in this chapter.

INDICATIONS AND CONTRAINDICATIONS

There is an indication for suture techniques in rhinoplasty, particularly primary rhinoplasty, in virtually every case. Any nasal tip that is not normal and that re-

quires reshaping is likely to benefit from the suture techniques described here. There are virtually no contraindications.

In a secondary case, suture techniques are used first to reshape the nasal tip. If suture techniques do not achieve the result because, for example, the cartilages are deficient or defective, cartilage grafting is used to restore the tip. However, the surgeon will likely select suture techniques as a first choice, because they are simple, fast, safe, and save donor cartilage.

Tip contour is controlled largely with various suture techniques.

PREOPERATIVE ASSESSMENT AND PLANNING

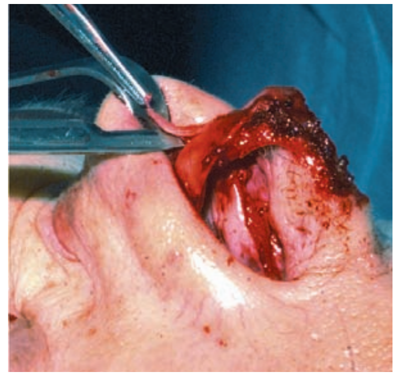
The patient for a rhinoplasty is assessed for any tip abnormalities. These include bulbosity (broad tip, wide tip, round tip, or boxy tip). When any of these abnormalities is present, the plan is suture tip-plasty. The first step of that plan is to convert the tip complex to a tripod in which two of the "legs" are lateral crura 6 mm wide. Wide lateral crura are relatively easy to control with sutures and can be relied on not to collapse. Crushing, bruising, scoring, or resection of the lateral crura to a smaller size causes weakness and complications such as rim collapse and alar retraction.

The third leg of that tripod is the paired middle/medial crura. The surgical plan therefore is to separate the cephalic part of the lateral crus to leave such a tripod and plan on shaping the tripod to normal anatomy. An anatomic model helps the surgeon determine what that shape should be rather than trying to memorize the various angles and dimensions.

The techniques described can all be done, and have been done, using the closed approach. The tip cartilages have to be delivered with intercartilaginous and marginal incision, and the process is not quite as exacting, but it can be done that way.

OPERATIVE TECHNIQUE

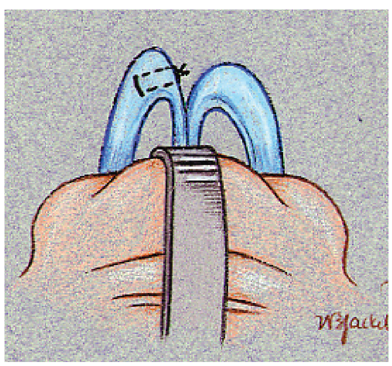
Suture Tip-plasty

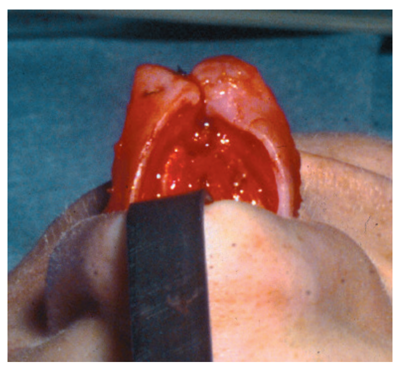


After the nose is opened and the tip cartilages exposed, an appropriately wide lateral crus is developed that should be approximately 6 mm wide. A lateral crus of that width is easiest to manipulate with sutures and has enough structural integrity to avoid collapse.

However, the surgeon must decide whether the cephalic component (sometimes called the *cephalic island*) needs to be preserved to avoid or minimize alar retraction (see Chapter 66). Otherwise, it should simply be excised. After that decision is made, a series of suture techniques are applied as needed to create a normal-shaped nasal tip framework.

Transdomal Suture

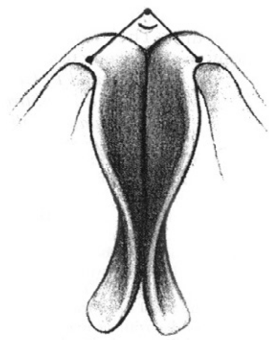




A 5-0 PDS horizontal mattress suture on P-3 needle is applied to the dome starting at the caudal end so that the knot is not in the supratip region. If the dome is difficult to identify, the tip cartilages are gently squeezed with forceps, which causes the dome to become more apparent. The suture is not tied too tight, but to the appropriate width. After that is done, the domes take on an axis, and the separation between thoses axes is usually about 90 degrees. Some improvement to the lateral crus convexity also occurs.

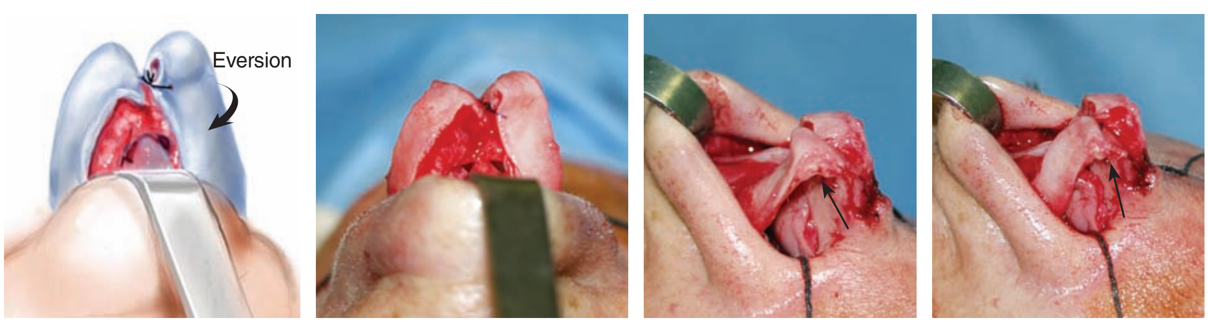
The transdomal suture narrows the dome.

Hemitransdomal Suture



When eversion of the lateral crus is desired, a hemitransdomal suture is useful and often replaces the transdomal suture. While the dome is held with a forceps, a 5-0 PDS simple suture is applied to the cephalic side of the dome. This squeezes only the cephalic side, causing the lateral crus to evert and even straighten slightly.

The hemitransdomal suture narrows the dome and everts it.



Transdomal suture Hemitransdomal suture

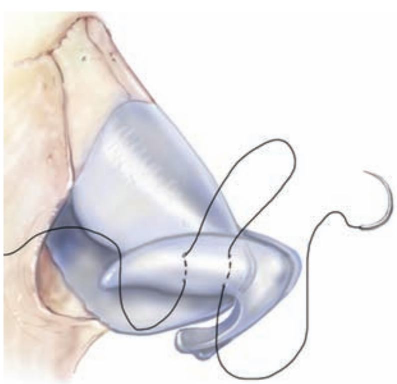
The two sutures (transdomal and hemitransdomal) can be compared side by side. This small amount of eversion is important if it is to minimize a pinching of the domes and a resultant rim concavity.

Interdomal Suture

Opening the nose, splitting the tip cartilages slightly to gain access to the anterior septal angle of the septum (to elevate mucoperichondrium and release upper lateral cartilages) are all necessary maneuvers but do result in some splaying of the domes and loss of strength and symmetry. The interdomal suture restores symmetry and corrects splaying. A 5-0 PDS suture is approximate the middle crura (on the cephalic side) at a level that is approximately 3 to 4 mm below (posterior to) the domes. The domes themselves are not sutured together because there is normally a small separation of a few mm between the cephalic end of the domes. If a columellar strut is planned, this suture is usually placed after the strut is put in place because strut placement can often be disrupting.

The interdomal suture restores tip strength and symmetry.

Lateral Crus Suture

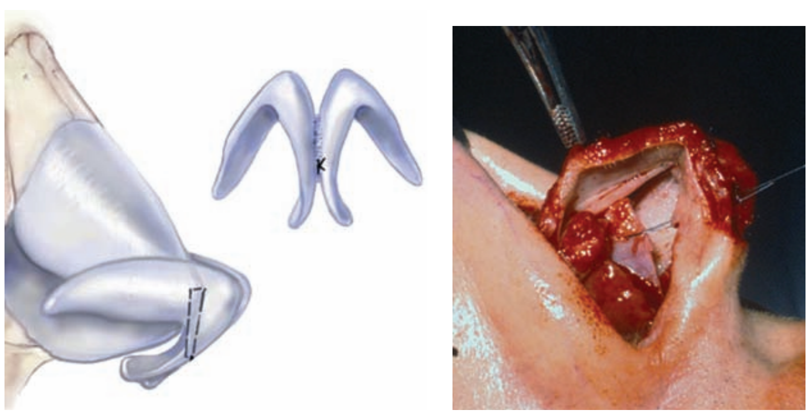


Any convexity of the lateral crus can be improved or reversed with a horizontal mattress suture of 5-0 PDS. While holding the most convex portion of the convex lateral crus, the suture needle is placed on one side of the forceps, perpendicular to the direction of the lateral crus trying to take as small a bite as possible. The second bite is taken on the other side of the forceps so that the distance between should be approximately 6 mm.

The knot is only tied tightly enough to flatten the convexity. Often a second or third lateral crus suture at different locations along the lateral crus is necessary to flatten out the entire length of the lateral crus. One should look at the very posterior (lateral) aspect of the lateral crus to see whether it curls in and becomes very convex. If so, that is a good location for a lateral crus suture too.

The lateral crus suture removes convexity of the lateral crus.

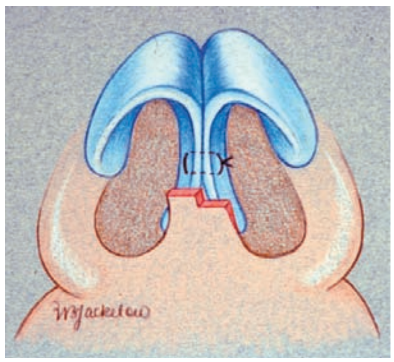
Columellar-Septal Suture

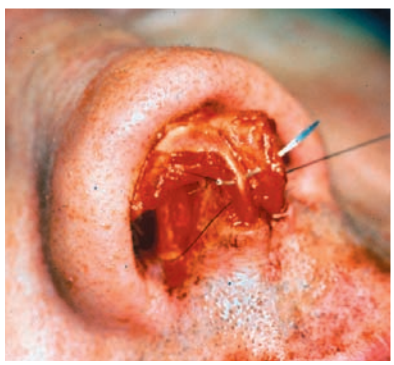


Occasionally a small adjustment of the tip complex with respect to the caudal septum is necessary. It may be desirable to secure the entire cartilaginous tip complex to the caudal septum, either projecting it or, if necessary, deprojecting it a little bit. The columellar-septal suture will do that but only to a small extent. It is not a substitute for serious projecting, such as can be achieved by a columellar strut, or serious deprojecting techniques such as resection of a portion of the posterior lateral crus or a section of the middle crus.

Beginning just caudal to the columella, a large needle 4-0 PDS suture is passed between the leaves of the middle crura, which contains strong fibers for a good purchase. The needle then picks up the anterior septal angle of the septum in two bites (because sutures tend to pull through if only one bite is used), and then the needle is passed back between the leaves of the middle crura, where the knot is tied. When the columellar part of the skin flap is reapplied, it will rest on and cover the knot. Care is taken not to overtighten the knot, which otherwise would cause columellar retraction.

Intercrural Suture





On occasion the caudal aspect of the middle crura tends to flare causing what would be a wide columella. At the anterior end of the middle crura such flaring can actually cause an unwanted broad infratip lobule. An intercrural suture narrows the width of the middle crura in this region. It is simply a 5-0 horizontal mattress suture not tightened too much but just enough to give the proper width to the columella.

The intercrural suture narrows the medial crura (columella).

CASE ANALYSES




This 32-year-old women had a bulbous nasal tip, dorsal hump, long nose, hanging columella, and broad nose.

The operative goals included the following:

- Use an open approach.
- Perform cephalic resection of the lateral crus.
- Employ suture techniques:
  - Transdomal
  - Interdomal
  - Lateral crus
  - Columellar-septal
- Perform a humpectomy.
- Place spreader flaps.
- Shorten the septum.

Twelve months after surgery, improvement in the size of her nasal tip and its proportions are evident. The nasal length and width are improved as well. However, the general width of the nose is still slightly large.

This 25-year-old woman presented with a broad round nasal tip and dorsal hump.

The operative goals included the following:

- Use an open approach.
- Perform cephalic resection of the lateral crus.
- Employ suture techniques:
  - Transdomal
  - Interdomal
  - Lateral crus
- Perform a humpectomy.
- Place spreader flaps.

Fifteen months after surgery there is improvement in her round, ill-defined tip. The basal view shows much better triangulation, although the columella is slightly broad. The profile is also improved.

This 33-year-old woman had a broad tip, medium-thick skin, and a radix deficiency.

The operative goals included the following:

- Use a closed approach.
- Deliver the tips through a marginal incision and an intercartilaginous incision.
- Employ suture techniques:
  - Hemitransdomal
  - Interdomal
  - Lateral crus
- Perform cephalic excision of the lateral crus.
- Augment the radix.

Twelve months after surgery, the nasal tip is narrower and the radix deficiency is somewhat improved, though not completely. Overall, the nostrils are more equilateral on basal view.

This 30-year-old woman presented with a broad tip, and a broad nose in the upper half; the tip was slightly overprojected, with a nasofacial angle that was somewhat obtuse.

The operative goals included the following:

- Employ suture techniques:
  - Lateral crus
  - Interdomal
  - Columellar-septal
  - Hemitransdomal
- Perform medial oblique and lateral osteotomies.
- Reduce the dorsum more at the caudal end.
- Place spreader flaps.
- Perform deprojection by releasing tip structures from the caudal septum.
- Slightly augment the radix.

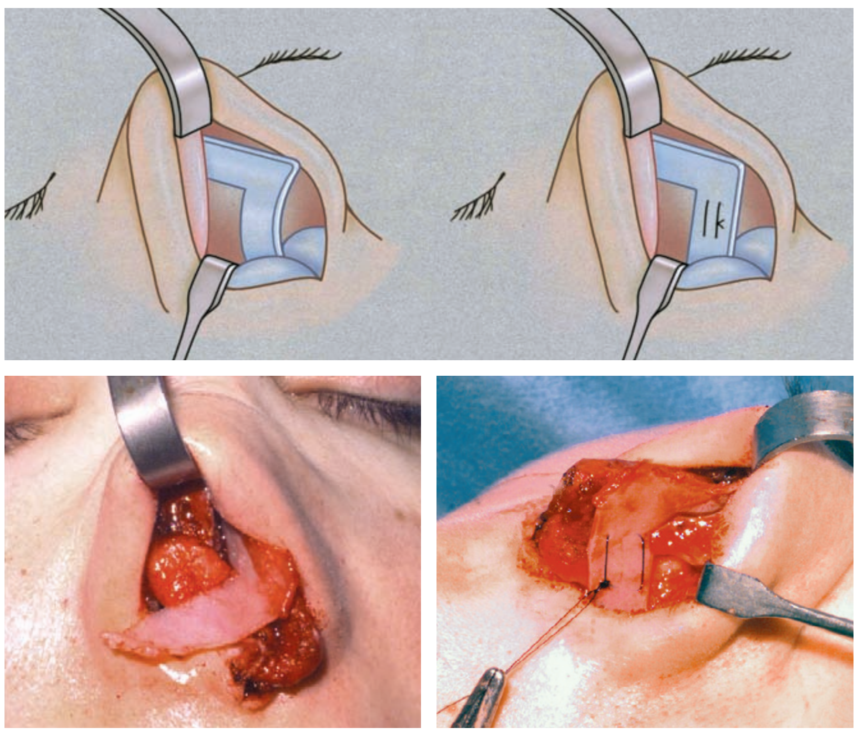
Thirteen months postoperatively, the tip is narrower, as is the upper half of the nose. The nasofacial angle is improved. The basal view reveals better equilateralization; however, the nostrils are slightly large.

THE UNIVERSAL HORIZONTAL MATTRESS SUTURE

The lesson learned from the lateral crus suture was that a horizontal mattress suture can be used universally in rhinoplasty. It can be used to remove the convexity of any strip of cartilage; conversely, it can be used to correct the concavity of any strip of cartilage, because concave cartilage is simply the inverse of convex cartilage, and the same horizontal mattress suture need only be applied to the opposite side of concave cartilage to flatten it. The following are a few examples.

Horizontal mattress sutures reduce the convexity of any cartilage.

Septal Deviation

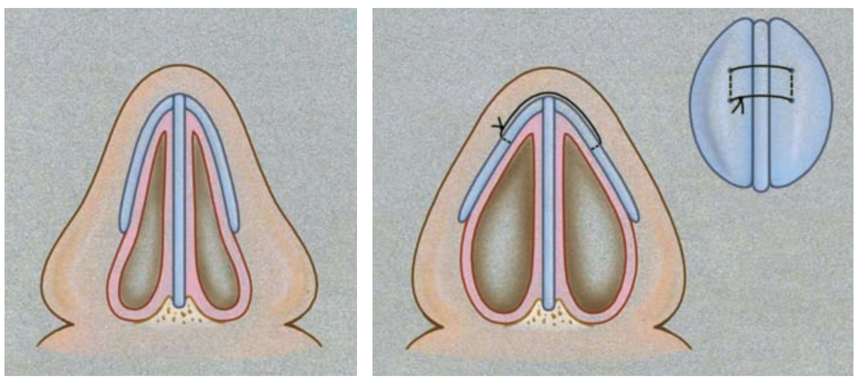


Vertical and horizontal components of an L-shaped septal strut are corrected by scoring and clocking sutures. However, there are times when the horizontal component is still not straight or shows signs of memory during the case by wandering back to its distorted position. If this occurs, horizontal mattress sutures are used. They are stronger sutures, because the septum is much stronger

and thicker than the lateral crus. One or more 4-0 PDS horizontal mattress sutures are placed on the convex side of the septal deformity. Great care should be taken to not overtighten the suture, which might cause a secondary distortion. It is better to use two or three gently placed sutures to straighten and strengthen the septum. This is of benefit for both the horizontal and vertical components. The horizontal mattress suture is particularly useful for the vertical component because it avoids the need for a batten graft to straighten the vertical component.

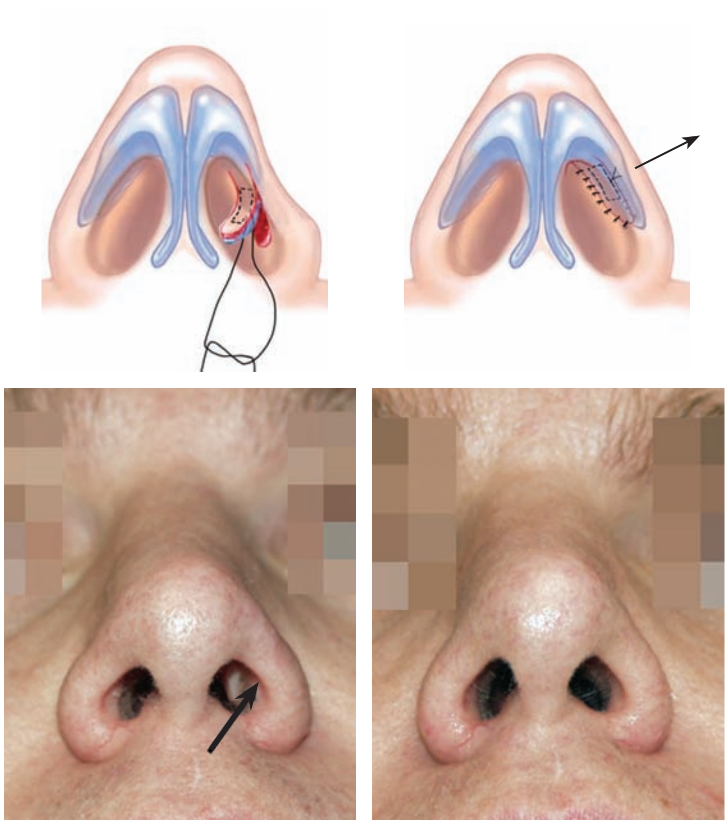
Septal straightening is facilitated with horizontal mattress sutures.

Persistently Collapsing Internal Valves



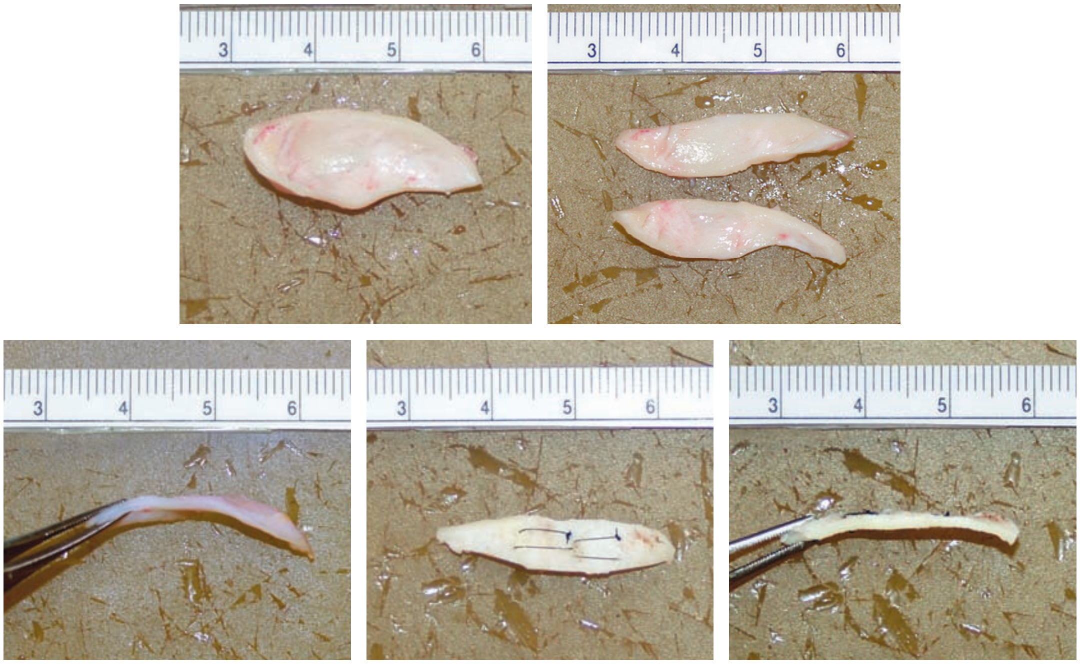
The conventional and uniformly successful treatment for collapsing internal valves is the spreader graft. However, on occasion the lateral wings of the upper lateral cartilage of the internal valves are not lifted enough by the insertion of spreader grafts. Consequently, a large horizontal mattress suture that spans the entire bilateral upper lateral cartilages can be helpful.[22,23] A forceps is used to pick up the upper lateral cartilage at a point (usually in its midpoint) where the valve starts to open up. A purchase of the cartilage is taken with a large needle 4-0 PDS suture and passed to the other upper lateral cartilage where the second purchase is made. As the knot is tied, one can usually see the "wings" of the upper lateral cartilage open and spread.

Collapsed Posterior (Lateral) Aspect of the Lateral Crus



Occasionally a postrhinoplasty patient will present with a cartilaginous prominence within the nostril vestibule. The patient is bothered by it because of a partial airway obstruction, and the prominence annoys the patient when he or she palpates it. It is corrected by incising the perimeter of the posterior lateral crus with a U-shaped incision that allows the lateral crus to be delivered as a flap. The result is that the underbelly of the lateral crus is exposed enough to allow the application of a horizontal mattress suture or two, which will straighten out and stiffen the lateral crus. The composite flap of the lateral crus is returned to its bed and sutured in place along its periphery with 5-0 plain catgut sutures.

Struts Made From Ear Cartilage



Compared with septal cartilage, ear cartilage is weaker and curved, rendering it less effective as a strut. However, the universal horizontal mattress suture changes these deficiencies.

Weak and curved strips of cartilage can be stiffened and straightened with horizontal sutures to make struts.

The concha cymba component of the sacrificable ear cartilages is approximately 2 cm long; it is shaped like a canoe (see Chapters 11 and 66). By splitting it down the middle, it becomes two curved, somewhat weak cartilages. However, by placing it concave-side down on a silicone block, horizontal mattress sutures can convert them into useful struts for either the columella or the lateral crus. A 5-0 PDS or Vicryl suture is placed on either end of the hemicymba cartilage graft. The distance between bites is only 4 mm, because the cartilage is small and weak. However, a mattress suture on either end is all that is necessary to make the cymba a much stronger and straighter graft.

COMPLICATIONS

The transdomal suture is an excellent suture for narrowing the dome. However, in so doing, the rim may become concave and require an alar contour rim graft. To minimize that possibility, use of a hemitransdomal suture reduces the chance of that potential complication.

Also, suture techniques can be overdone. If the lateral crus suture is overtightened in an attempt to straighten its convexity, the lateral crus may inadvertently become concave.

Sutures can on occasion become exposed in the nasal vestibule, inciting a small microabscess formation and an odor that the patient notices. It is treatable with antibiotics such as cephalosporins and seldom needs exploration. The problem of suture exposure is best avoided by using nonabsorbable sutures, particularly PDS.

CONCLUSION

Suture techniques for the nasal tip allow the surgeon to create a normal architectural shape. A few of the many available suture techniques are recommended: the transdomal or hemitransdomal suture, the interdomal suture, the lateral crus suture, and the columellar-septal suture. Additionally, the horizontal mattress suture is a universal suture that potentially removes unwanted convexity (concavity) from cartilages. One or more horizontal mattress sutures applied to the convex side of a piece of cartilage will strengthen it and reduce its convexity. This allows otherwise unusable cartilages, such as auricular cartilage, to be fashioned into struts for the columella and lateral crus. These same horizontal mattress sutures are helpful to straighten septal L-struts that are deviated.

KEY POINTS

- Tip contour is controlled largely with various suture techniques.
- The transdomal suture narrows the dome.
- The hemitransdomal suture narrows the dome and everts it.
- The interdomal suture restores tip strength and symmetry.
- The lateral crus suture removes convexity of the lateral crus.
- The intercrural suture narrows the medial crura (columella).
- Horizontal mattress sutures reduce the convexity of any cartilage.
- Septal straightening is facilitated with horizontal mattress sutures.
- Weak and curved strips of cartilage can be stiffened and straightened with horizontal sutures to make struts.

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19

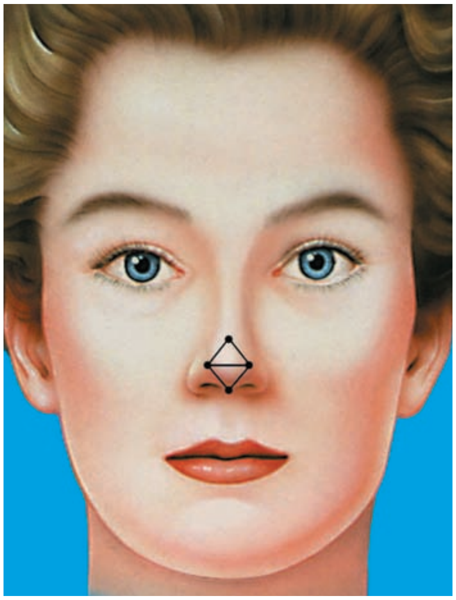
Achieving Aesthetic Balance of the Infratip Lobule

Rod J. Rohrich ▪ Jerome H. Liu ▪ Jamil Ahmad

Complex relationships exist throughout the nose, particularly in the lower third,[1] which encompasses the nasal tip, columella, alae, and lobule.[2] Many approaches and techniques have been described for nasal tip and alar contouring.[3-6] Conversely, very little attention has been given to the infratip lobule, which is a challenging area because its shape, size, and position are influenced by alar-columellar relationships, tip rotation, the anterior septal angle, and underlying lower lateral crural malformation or malposition. These relationships are dynamic, and changes in one part of the nose can dramatically alter the infratip lobule.[1,7] Successful management of the infratip lobule depends on clinical analysis and a sequential approach to its correction.

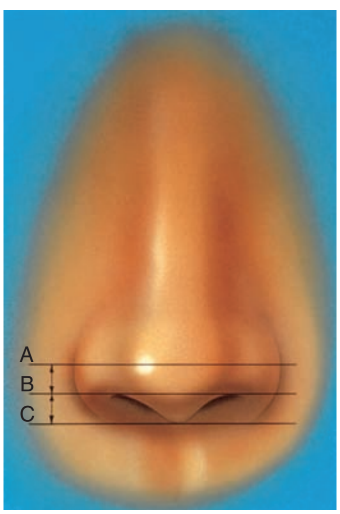
Chapter adapted from Rohrich RJ, Liu JH. Defining the infratip lobule in rhinoplasty: anatomy, pathogenesis of abnormalities, and correction using an algorithmic approach. Plast Reconstr Surg 130:1148-1158, 2012.

ANATOMY OF THE INFRATIP
Defining the Infratip Lobule

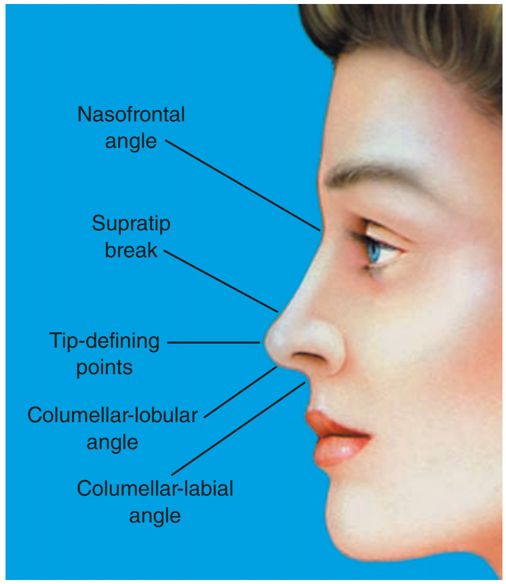


The infratip lobule is the area of the nose bounded by the tip-defining points superiorly and the columella caudally. Laterally it borders the soft triangle and the apex of the nostril. The infratip lobule occupies a central location on the tip just below the tip-defining points, and counterbalances the supratip break.[1]

The infratip lobule is the area of the nose bounded by the tip-defining points superiorly, the columella caudally, and the soft triangles and the apices of the nostrils laterally.

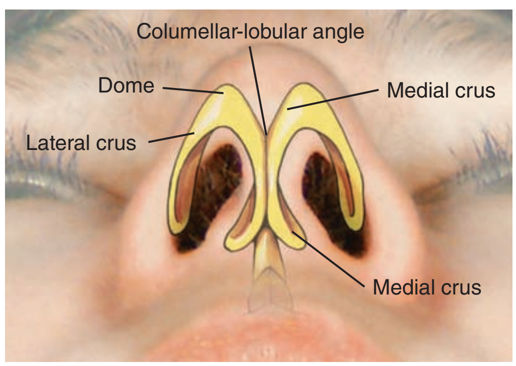


On the frontal view, infratip lobular projection is defined by lines drawn through the tip-defining points *(A)* and the inferior extent of the lobule[2] *(C)*. In an ideal nose, the nostril apices *(B)* coincide with the midpoint of the infratip lobule.[1]



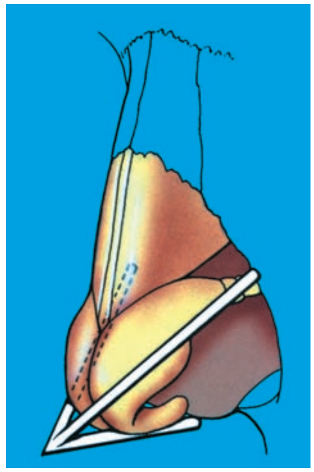
On the lateral view, the infratip lobular projection is delineated by the tip and the columellar-lobular angle. The infratip lobule is influenced by the alar-columellar relationship.

Anatomy of the Lower Lateral Cartilages at the Infratip Lobule



The trajectory, length, and strength of the middle crura of the lower lateral cartilages define the shape, contour, and projection of the infratip lobule.[2] The lower lateral cartilages are divided into three crura[8]: medial, middle, and lateral.[2] These three crura are intimately related and undergo complex interactions when manipulated.

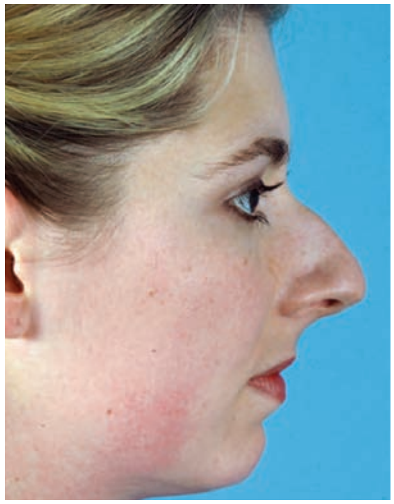
The trajectory, length, and strength of the middle crura of the lower lateral cartilages define the shape, contour, and projection of the infratip lobule.



The medial crus becomes the middle crus at the columellar-lobular junction, and the middle crus becomes the lateral crus at the domal junction.[9] The medial crus determines tip projection and tip support and serves as the caudal leg of the nasal tripod.[10,11] At the junction of the medial and middle crura, the trajectory of the lower lateral cartilage changes to a more cranial direction, rotating along its long axis. This change in angulation defines the columellar-lobular angle and marks the beginning of the infratip lobule. The middle crus diverges from the midline to form the dome of the lower lateral cartilage. This dome marks the transition of the middle crus to the lateral crus and corresponds to the tip-defining points, which delineate the superior aspect of the lobule. The lateral crura determine the amount of alar support and tip rotation, forming the other two (cranial) legs of the nasal tripod.

CLINICAL ANALYSIS AND PLANNING

Clinical nasal analysis is performed in a systematic fashion that is well described in Chapter 6. Evaluation of the infratip lobule begins with the alar-columellar relationship and the shape of the lower third of the nose. The alar-columellar relationship is influenced by the underlying interactions between the medial, middle, and lateral crura.[11] The shape and strength of the lower lateral cartilage can be estimated by examination of the alar-columellar relationship.[12] Establishment of a normal alar-columellar relationship will ensure proper positioning of the medial, middle, and lateral crura.



Anatomically the infratip lobule overlies the middle crura of the lower lateral cartilages. As a result, the shape and projection of the infratip lobule are based on the middle crura. Specific deformities of the middle crura are often revealed intraoperatively. However, evaluation of the basal view can provide an indication of their length. In an ideal nose, the columella/lobule ratio is approximately 2:1. When the lobular portion is excessive, the middle crura are likely elongated. Equally important is the angle of departure between the lateral crus and the alar rim and the rotational orientation of the lateral crus with respect to its cranial and caudal edges.[2] A lateral crus with a large angle of departure from the alar rim will have a recessed and weak facet, causing a pinched tip and overprojected infratip lobule. This is often superimposed onto an abnormal rotational orientation with the caudal edge of the lateral crus below the cranial edge, which compounds the deformity. Alar support procedures such as a lateral crural strut graft or alar contour graft can often compensate for weaknesses in alar support.[5,6] This configuration is common in patients undergoing primary rhinoplasty who have very weak lower lateral cartilages. A rotational orientation with the caudal edge above the cranial edge will produce alar notching and nostril flaring, also leading to excess infratip lobular projection. Deformities including alar retraction or discrepancies in the alar-columellar relationship are seen in secondary rhinoplasty patients who have a weak or diminutive lower lateral cartilage after overzealous excision.

Infratip lobular deformity can be caused by structures other than the lower lateral cartilage. Prominence of the anterior septal angle and caudal septum, plunging tips, and tension tips can lead to excess infratip lobular projection. Maneuvers that correct these problems include caudal septal resection and dorsal reduction, with appropriate medial crural and columellar support.

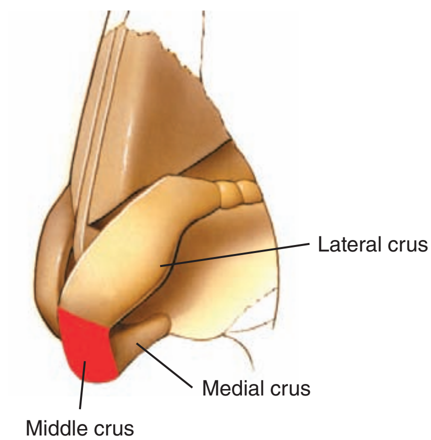
CLASSIFICATION OF INFRATIP LOBULAR DEFORMITIES

Five types of infratip lobular deformities have been described. Their cause is either intrinsic or extrinsic. *Intrinsic* causes are deformities or abnormalities in the lower lateral cartilage, whereas *extrinsic* causes involve structures other than the lower lateral cartilage. Correct classification is dependent on a thorough preoperative nasal analysis and intraoperative confirmation of the anatomy.

Classification and Causes of Infratip Lobular Deformities

Type	Cause
I	Intrinsic; middle crus too long
II	Intrinsic; middle crus too wide
III	Intrinsic; lower lateral cartilage malposition or asymmetry
IV	Intrinsic; combination of intrinsic type I, II, and III abnormalities
V	Extrinsic; prominent caudal septum or anterior septal angle

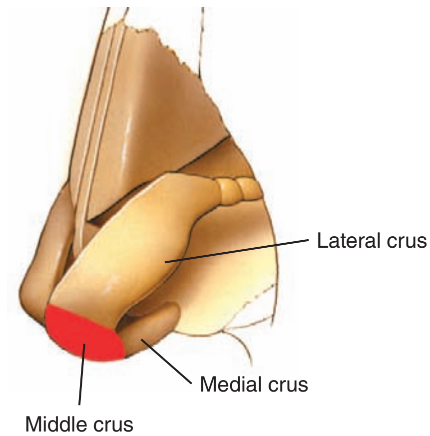
Type I: Intrinsic, Middle Crus Too Long



In type I deformities, the middle crus is too long.[2] The excess vertical height of the middle crus is limited by its surroundings, causing it to buckle or bow outward inferiorly. This results in excess infratip lobular projection. Depending on the relative lengths of the middle crura, this can be symmetrical or asymmetrical between the left and right sides. In addition to an overprojecting lobule, the deforming forces of a buckled middle crus can cause asymmetries of the lateral crus or the tip-defining point, leading to associated tip asymmetries.

In type I infratip lobular deformities, the excess vertical height of the middle crus is limited by its surroundings, causing it to buckle or bow outward inferiorly. This results in excess infratip lobular projection.

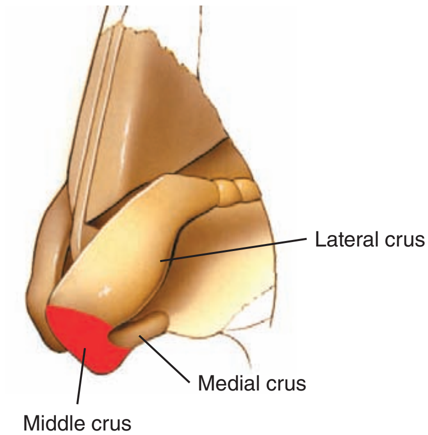
Type II: Intrinsic, Middle Crus Too Wide



In type II infratip lobular deformities, the middle crus is too bulky or wide.[2] This may or may not be associated with discrepancies in vertical height. A wide middle crus will push on the infratip lobule, causing overprojection. Although the trajectory of the middle crus is within normal limits, the effect of bulk and width pressing on the soft tissue envelope is prominence of the infratip lobule. This deformity is often seen in conjunction with a boxy or bulbous tip.

In type II infratip lobular deformities, a wide middle crus pushes on the infratip lobule, causing overprojection.

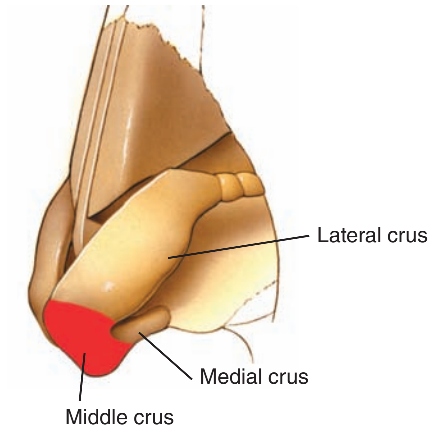
Type III: Intrinsic, Lower Lateral Cartilage Malposition or Asymmetry



Type III infratip lobular deformities have a malpositioned or asymmetrical lower lateral cartilage.[2] This most often relates to the angle of departure between the lateral crus and the alar rim or to the rotational orientation of the lateral crus with respect to its cranial and caudal edges. In an ideal infratip lobular projection, the cranial and caudal edge of the lateral crus lie in the same plane. Malposition of the lower lateral cartilage is often superimposed on intrinsic asymmetries or deformities that require suture correction.

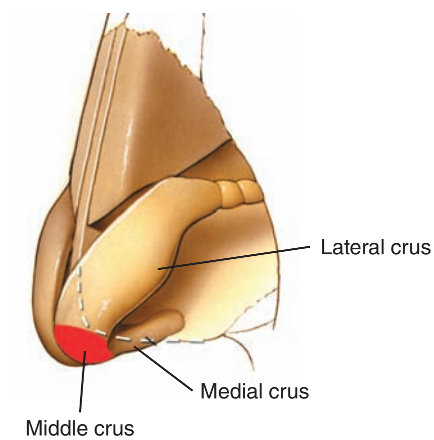
Type III infratip lobular deformities most often relate to the angle of departure between the lateral crus and the alar rim or to the rotational orientation of the lateral crus with respect to its cranial and caudal edges.

Type IV: Intrinsic, Combination of Type I, II, and III Abnormalities



Type IV infratip lobular deformities involve a combination of types I, II, and III.[2] Multiple asymmetries and deforming forces are common, and the middle crus is too long (type I) and too wide (type II). The left and right middle crura may be similar but are often asymmetrical. Deformities of the middle crura are often superimposed on abnormalities of lower lateral cartilage (type III).

Type V: Extrinsic, Prominent Caudal Septum or Anterior Septal Angle



Type V infratip lobular deformities are extrinsic to the lower lateral crura.[2] A prominent caudal septum or anterior septal angle can displace the infratip lobule, causing prominence. Septal abnormalities can also cause distortions in nasal length (long nose), nasal height (tall nose), the columellar-labial angle, or the columellar-lobular angle, all of which can lead to a perceived excessive infratip lobular projection. Furthermore, septal prominence can contribute to a tension tip or a plunging tip, causing overprojection of the infratip lobule.

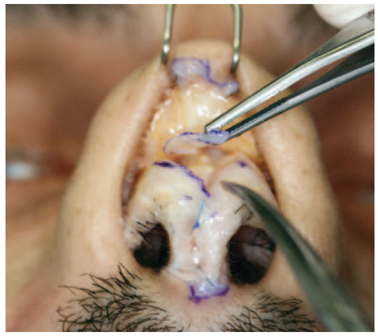
OPERATIVE TECHNIQUE

The operative technique requires analysis and classification of the infratip lobular abnormalities. The surgical approach to the correction of excess infratip lobular projection treats each type of deformity in a stepwise fashion from medial to lateral.

The surgical approach to the correction of excess infratip lobular projection treats each type of deformity in a stepwise fashion from medial to lateral.

If a prominent caudal septum is causing overprojection of the middle crus and infratip lobule, the caudal septum is trimmed.

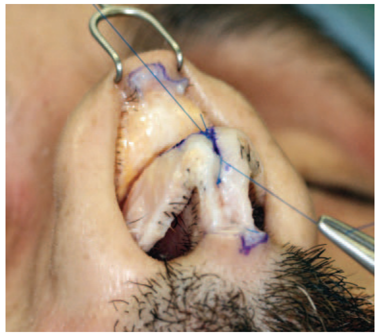
The first maneuver in the correction of intrinsic deformities is to verticalize the medial crus by placing a medial crural suture. This maneuver will define the junction of the medial and middle crura.[2] With the incorporation of portions of the middle crus, a high intercrural suture can shorten the middle crus by absorbing its length and by definition control the projection of the infratip lobule. This suture also begins to define the amount of tip projection and provides a stable middle base for the nasal tripod. In patients with weak tip support, a columellar strut graft is incorporated. This technique is used to treat type I deformities.



The shape of the middle crus can be changed by cephalic trim, and in some cases caudal trim is required. This will control its width.[2] Excess width or bulk of the middle crus can lead to excess infratip lobular projection and paradomal fullness and bulbosity. Cephalic trim is performed to create symmetrical crura and improve tip definition and lower lateral symmetry. If the lower lateral cartilage is weak or convoluted, a lateral crural turnover flap can be placed to narrow the width of the alar rim strip while using the intrinsic forces in the cartilage to improve the shape and strength of the lateral crus. The caudal aspect of the middle crus can be trimmed if necessary. If tip support is a concern, resection of the anterocaudal septal angle can achieve the same effect as caudal trim of the middle crus without weakening the lower lateral cartilage. This technique is used to treat type II deformities.

The junction of the middle and lateral crura is set using an interdomal suture. [2] In some cases, a shaped columellar strut graft with intercrural sutures is required. Placement of the initial interdomal suture narrows the angle of divergence and begins the process of defining the junction of the middle crus with the lateral crus and the tip-defining points. This technique is used to treat type III and type I deformities.

The junction of the middle and lateral crura is set using an interdomal suture.



At this point, intrinsic asymmetries of the lower lateral cartilages are noted, and the rotational orientation of the lateral crus is adjusted. Transdomal sutures will define the junction of the middle and lateral crura, establish the length and shape of the middle crus, and determine infratip lobular projection.[2] Transdomal sutures are usually placed toward the leading edge of the lower lateral cartilage. A slightly more caudal placement derotates the tip and controls the infratip lobular projection. Differential placement of transdomal sutures in the craniocaudal dimension allows shaping to improve symmetry of the domes and changes the rotational orientation of the lateral crus. These sutures will finalize the shape of the tip-defining points and the infratip lobule. The endpoint of transdomal suturing is a straight and flat lateral crus and proper rotational orientation.

The endpoint of transdomal suturing is a straight and flat lateral crus and proper rotational orientation.

The more convex the lateral crus, the larger the bite and the more lateral the placement. A lateral crus that is less convex requires a more medial, smaller bite. The final result of transdomal suture placement is a symmetrical, aesthetic nasal tip with well-proportioned crura. The precise placement of the transdomal sutures cannot be overemphasized. The position and orientation of the transdomal sutures will sculpt the tip and rotate the lateral crus. The rotation of the lateral crus will determine the rim elevation and the appearance of the infratip lobule. Alar rim position corresponding to a rotational level in which the cephalic and caudal edges are on the same plane will provide an ideal infratip lobular projection.

Alar rim position corresponding to a rotational level in which the cephalic and caudal edges are on the same plane will provide an ideal infratip lobular projection.

In situations in which the lateral crus is slightly overrotated because of suture placement for tip projection or tip sculpting, an alar contour graft or lateral crural strut graft can correct the rim position.[5,6] The need for alar rim support is based on the trajectory of the lateral crus. Adequate alar rim support and preservation of the normal alar-columellar relationship ensure that the perceived lobular projection equals the actual projection.

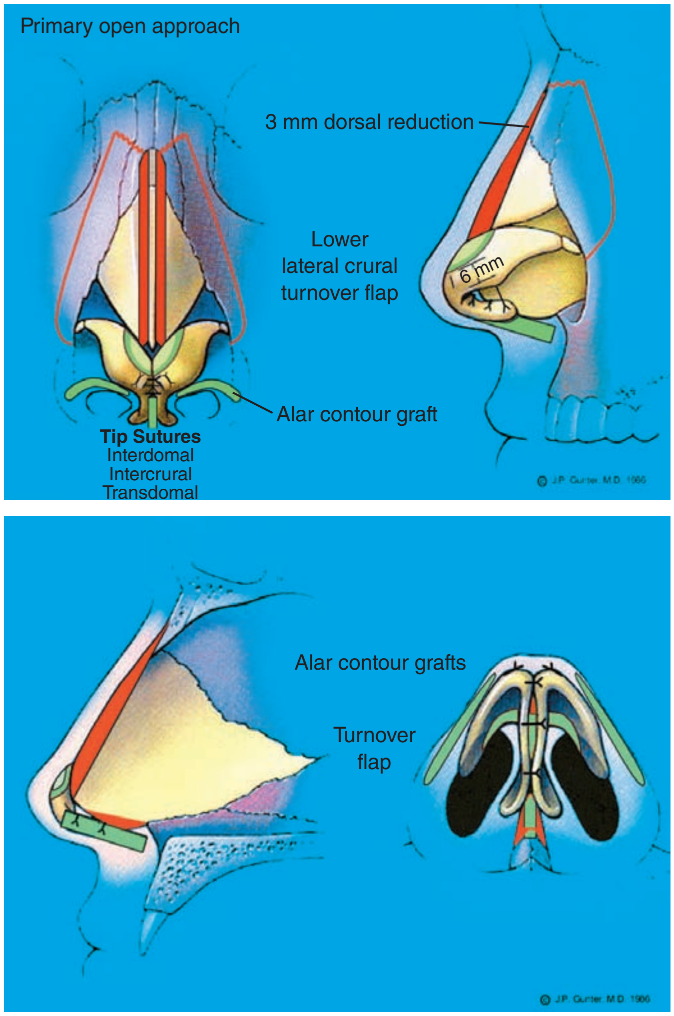
Adequate alar rim support and preservation of the normal alar-columellar relationship ensure that the perceived lobular projection equals the actual projection.

CASE ANALYSES

This patient had a mildly prominent caudal septum (type V extrinsic deformity). On the frontal view, her nostril apex was cranial to the midpoint of the lobule, and she had mild alar retraction.[2] These findings were consistent with a type III deformity with lower lateral malposition and abnormal rotational orientation of the lower lateral cartilage. Additionally, she had a dorsal hump, no supratip break, and a slight hanging tip. Intraoperatively she was noted to have a long (type I) and wide (type II) middle crus with very convex lower lateral cartilages.

The operative goals included the following:

- Reduce the dorsal hump.
- Re-create symmetrical dorsal aesthetic lines.
- Correct the caudal septal deviation.
- Improve tip definition and balance.



Surgical Plan

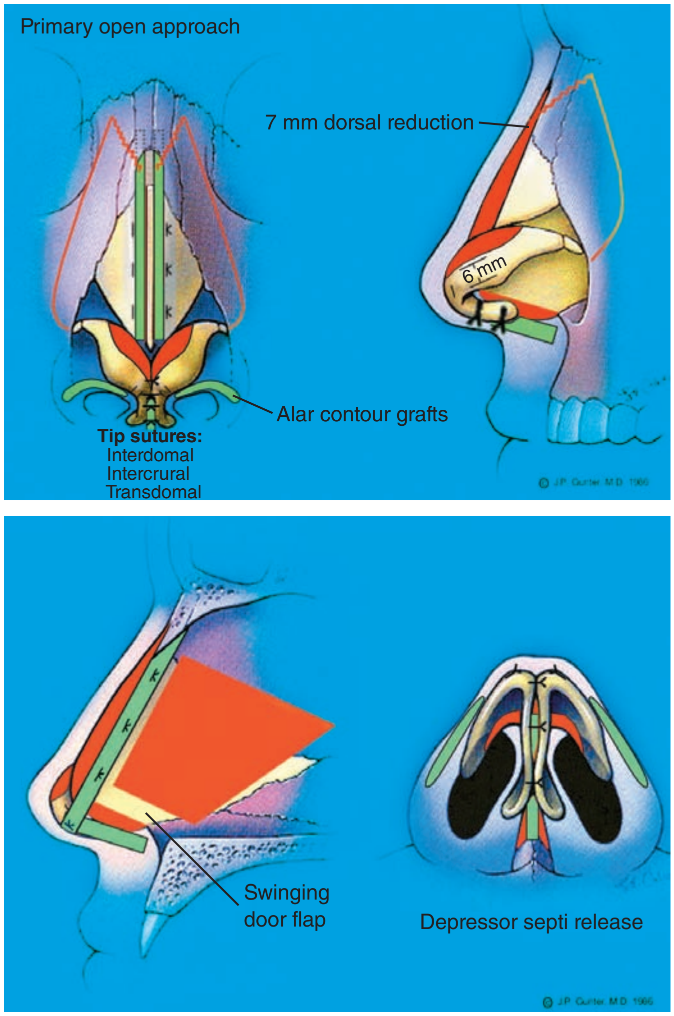
1. Perform an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions
2. Reduce the dorsal hump by 3 mm in component fashion.
3. Resect the caudal septum.
4. Apply lower lateral crural turnover flaps, and preserve a 6 mm alar rim strip.
5. Place a columellar strut graft.
6. Place intercrural, interdomal, and transdomal sutures.
7. Perform low-to-low percutaneous perforated lateral osteotomies.
8. Place alar contour grafts.

Postoperatively the patient has symmetrical dorsal aesthetic lines, a corrected dorsal hump, a narrowed bony base, and a refined tip.[2] The basal view shows narrowing of the nasal tip and improvement of the caudal septal deviation.

This patient had a tension tip and prominent caudal septum (type V extrinsic deformity). The frontal and lateral views showed a mildly retracted ala and an abnormal alar-columellar relationship, suggesting lower lateral cartilage malposition and abnormal rotational orientation, which indicated a type III deformity.[2] Additionally, she had a reverse-C–shaped dorsal deviation, a large dorsal hump, caudal septal deviation, and an overprojected tip. Intraoperatively her middle crus was long (type I) and wide (type II).

The operative goals included the following:

- Reduce the dorsal hump.
- Straighten the nose.
- Create symmetrical dorsal aesthetic lines.
- Correct the caudal septal deviation.
- Decrease projection of the tension tip.
- Improve tip definition and balance.



Surgical Plan

1. Perform an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Reduce the dorsal hump by 7 mm in component fashion.
3. Harvest septal cartilage, preserving an L-strut.
4. Reposition the caudal septum onto the anterior nasal spine.
5. Perform transnasal release of depressor septi nasi muscle.
6. Perform cephalic trim, maintaining a 6 mm alar rim strip.
7. Apply bilateral spreader grafts.
8. Place a columellar strut graft.
9. Use intercrural, interdomal, and transdomal sutures.
10. Perform low-to-low percutaneous perforated lateral osteotomies.
11. Place alar contour grafts.

Eighteen months postoperatively, the patient demonstrates a straight dorsum, symmetrical dorsal aesthetic lines, a corrected dorsal hump, and decreased projection and refinement of the tip.[2] Her basal view shows narrowing of the nasal tip and correction of the caudal septal deviation.

CONCLUSION

The infratip lobule is central to the lower third of the nose. Establishment of an algorithm and endpoints for the variety of surgical maneuvers is essential for consistent and predictable results. Our method of medial to lateral stepwise correction provides aesthetic results when used in conjunction with our overall surgical philosophy in rhinoplasty.

KEY POINTS

- The infratip lobule is the area of the nose bounded by the tip-defining points superiorly, the columella caudally, and the soft triangles and the apices of the nostrils laterally.
- The trajectory, length, and strength of the middle crura of the lower lateral cartilages define the shape, contour, and projection of the infratip lobule.
- In type I infratip lobular deformities, the excess vertical height of the middle crus is limited by its surroundings, causing it to buckle or bow outward inferiorly. This results in excess infratip lobular projection.
- In type II infratip lobular deformities, a wide middle crus pushes on the infratip lobule, causing overprojection.
- Type III infratip lobular deformities most often relate to the angle of departure between the lateral crus and the alar rim or to the rotational orientation of the lateral crus with respect to its cranial and caudal edges.
- The surgical approach to the correction of excess infratip lobular projection treats each type of deformity in a stepwise fashion from medial to lateral.
- The junction of the middle and lateral crura is set using an interdomal suture.
- The endpoint of transdomal suturing is a straight and flat lateral crus and proper rotational orientation.
- Alar rim position corresponding to a rotational level in which the cephalic and caudal edges are on the same plane will provide an ideal infratip lobular projection.
- Adequate alar rim support and preservation of the normal alar-columellar relationship ensure that the perceived lobular projection equals the actual projection.

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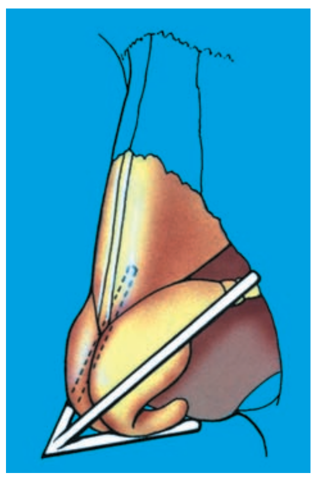
Structural Grafting of the Nasal Tip

Nazim Cerkes

For a rhinoplasty to be successful, the nasal tip must be well defined and project properly. This requires accurate preoperative diagnosis of the nasal tip's structural deformities.

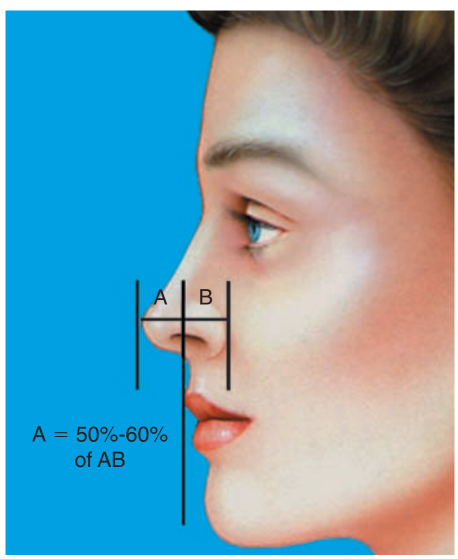


The lower third of the nose has a tripod-like support structure that is made up of the conjoined medial crura and lateral crural complex based bilaterally on the piriform aperture[1] (see Chapter 40). The medial crura together form one leg of the tripod, and the lateral crura make up the other two legs. The middle crura act as a transition between the different planes of the lateral and medial crura and contribute to the double break and infratip lobule. In rhinoplasty, the tripod should be maintained and/or restored to provide tip support and a normal-appearing nasal tip shape.

The lower third of the nose has a tripod-like support structure that is made up of the conjoined medial crura and lateral crural complex based bilaterally on the piriform aperture. Reconstructing a stable tripod structure supports the nasal tip, strengthens the alar sidewalls, and provides an aesthetically pleasing nasal tip.

Major tip support mechanisms must be understood and respected in both primary and secondary rhinoplasty.[1-32] The main components of tip support include the length and the strength of the lower lateral cartilages, the attachment of the cephalic margin of the lateral crura to the caudal margin of the upper lateral cartilages, and the ligamentous attachments between conjoined medial crura and caudal septum. If any of these support mechanisms is interrupted, various surgical maneuvers must be used to reinforce the tip support.

Airway obstruction resulting from nasal valve collapse is usually attributed to lateral nasal wall weakness. Nasal functional problems after rhinoplasty include internal and external nasal valve collapse. External nasal valve dysfunction is caused by medial displacement of alar rims during forced inspiration. This problem is caused by the structural weakness of the alar rims. The alar rims need to be supported with cartilage grafts for treatment of external nasal valve collapse.



Adequate tip projection is defined as the presence of 50% to 60% of the tip lying anterior to the most projecting point of the upper lip. One of the vital steps of a rhinoplasty operation is to control the nasal tip projection and position. The length and strength of the medial crura is critical for tip projection and definition. The shape and stability of the lateral crura are additional important factors for aesthetic and functional outcomes.

Preservation or reconstitution of a stable, well-defined nasal tip framework is indispensable for a successful rhinoplasty operation. The structural approach to the nasal tip enables the surgeon to strengthen the tip framework, reinforce the disrupted support mechanisms and control the position of the nasal tip to resist the forces imparted by scar over the long term.

Preserving or reconstituting the structural nasal framework is essential for consistent and successful long-term results.

The open rhinoplasty approach provides better visualization without distortion of cartilages, leading to accurate diagnosis and treatment.

The open rhinoplasty approach provides better visualization without distortion of cartilages, leading to accurate diagnosis and treatment.

In modern rhinoplasty, lower lateral cartilage grafting has been frequently used to strengthen and reshape the lower lateral cartilages. Autologous cartilage is the best material for structural grafting of the nasal tip.

Various lower lateral cartilage deformities require cartilage grafting for more predictable and consistent outcomes. These deformities can be grouped as follows:

1. Curvature deformities of the lateral crura
2. Cephalic malposition of the lateral crura
3. Weak lower lateral cartilages
4. Short lower lateral cartilages
5. Congenital deformities of the lower lateral cartilages
6. Secondary deformities of the lower lateral cartilages

CARTILAGE GRAFTS FOR STRUCTURAL GRAFTING OF THE LOWER LATERAL CARTILAGE COMPLEX

Autologous cartilage grafting is the preferred treatment, when structural grafting of the tip cartilages is needed. If available, septal cartilage is the graft of choice for autologous cartilage grafting because it is rigid, relatively straight and in the same operative field. It can be used as a columellar strut to support the nasal tip or replace parts of the lower lateral cartilage complex and spreader grafts as needed. However, septal cartilage is often insufficient in secondary operations.

Autologous cartilage grafting is the preferred treatment, if structural grafting of the tip cartilages is considered. If available, septal cartilage is the graft of choice for autologous cartilage grafting.

Auricular cartilage can be used to replace lateral crural defects. Onlay tip grafts and shield-type tip grafts can be prepared from concha. However, flaccidity and convolutions inherent in its structure limit the use of auricular cartilage in structural grafting.

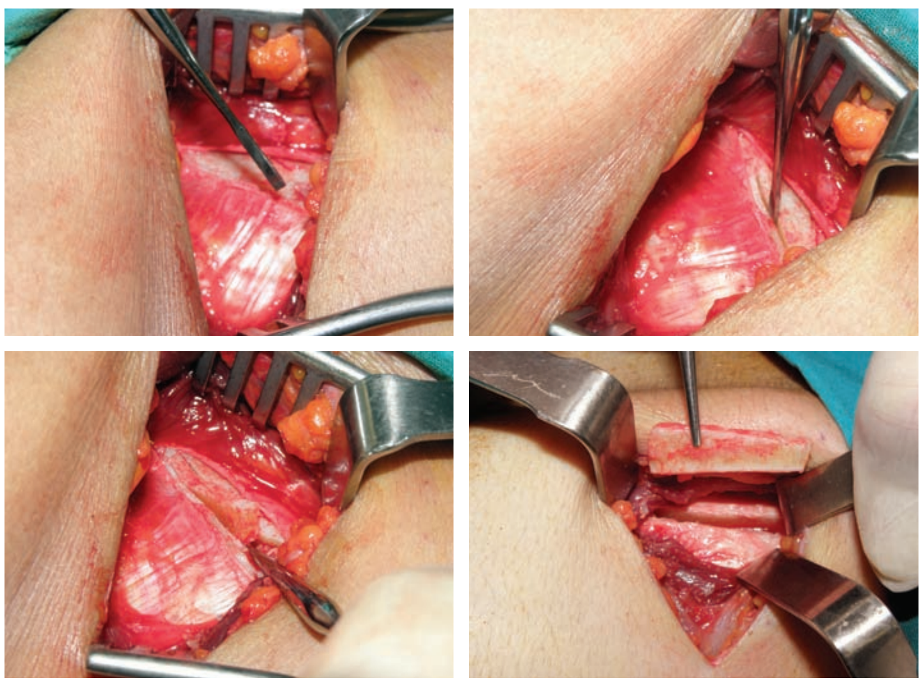
If significant support is required, autologous rib cartilage is the graft of choice. Rib offers an unlimited amount of cartilage for structural grafting. Long, straight struts can be prepared from the rib cartilage for reinforcement or reconstruction of the lower lateral cartilage complex. Rib cartilage is less calcified and more elastic in young individuals, and this allows the preparation of ultrathin grafts for lower lateral cartilage reconstruction.

If significant support is required, autologous rib cartilage is the graft of choice. Long, straight struts can be prepared from rib cartilage for reinforcement or reconstruction of the lateral crural complex.

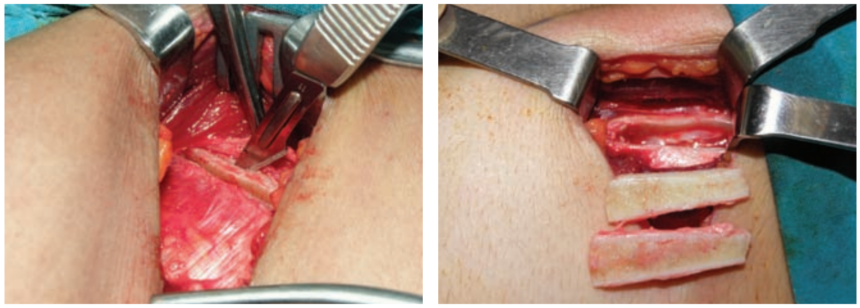
Operative Technique for Rib Cartilage Harvest

A 4 to 5 cm incision is made along the inframammary fold in female patients. In male patients the incision is kept shorter, usually around 2.5 to 3 cm and is placed exactly on the rib cartilage to be harvested. The straightest portions of the sixth and seventh ribs are ideal to obtain cartilage grafts for structural grafting.

After elevation of the perichondrium, a longitudinal incision is performed on the rib using a No. 11 or 15 blade. Another parallel incision about 1 to 1.5 mm apart is performed.



Using a semisharp, fine and straight-tip elevator (to avoid injury to the pleura) the incisions are completed to full cut and a straight rectangular cartilage graft is harvested.



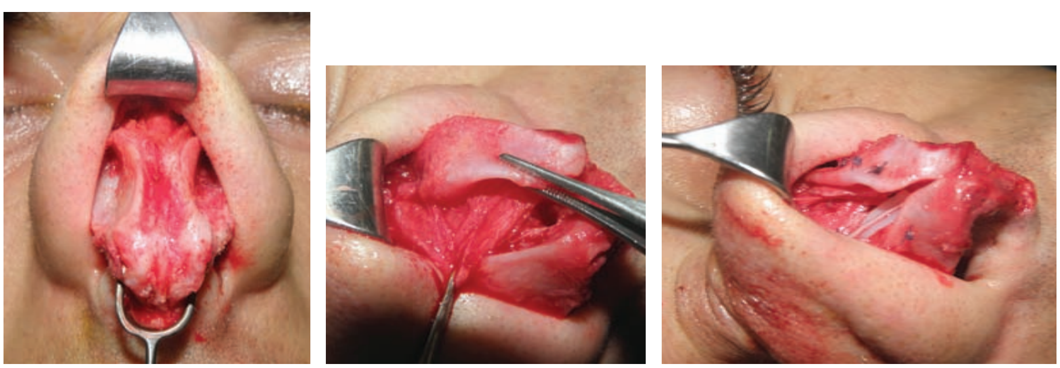
After the first graft is taken, it is much easier to harvest a second, third, or fourth piece using the same technique. This technique facilitates the graft harvest, reduces postoperative morbidity, and shortens the operating time.

CURVATURE DEFORMITIES OF THE LATERAL CRURA

Curvature deformities of the lateral crura cause an unpleasant appearance of the lower third of the nose and sometimes compromise nasal function. The most common curvature deformities are excessively convex lateral crura, presenting as a bulbous or boxy nasal tip and excessively concave lateral crura. Some unusual and asymmetrical curvature deformities of lateral crura can be seen.

Concave Lateral Crura

Concave lateral crura are cosmetically displeasing and may cause dysfunction of the external nasal valve, resulting in vestibular airway obstruction.



In minor concavity deformities with wide lateral crura, a lower lateral crural turnover flap or lateral crural turn-in flap can be used to correct the deformity. In the lateral crural turn-in flap technique an incision is made longitudinally on the lateral crura, leaving a 6 to 7 mm intact alar rim strip, similar to when cephalic trim is performed. The cephalic portion of the lateral crus is turned into a pocket created under the remaining lateral crus and fixed with two or three sutures. The

lateral crural turn-in flap reshapes and supports the lateral crura and internal nasal valve. This is also a useful technique for patients with weak lateral crura.

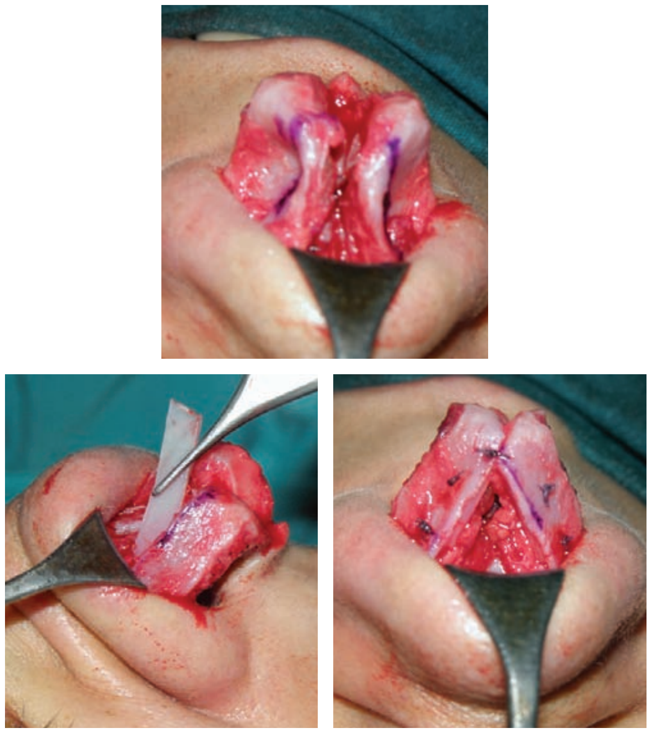
Excessively concave lateral crura cause a pinched deformity on the nasal tip and a nasal airway compromise. In cases of severe concavity of the lateral crus, the most predictable method of correction is placement of a lateral crural strut graft into a pocket underneath the lateral crus. After cephalic resection of lateral crus leaving at least a 6 to 7 mm intact alar rim strip, the graft is placed on the undersurface of lateral crus and secured to the lateral crus with two or three sutures. The lateral crural strut graft corrects concavity of the lateral crura and improves external nasal valve patency.

Case Analysis

This 23-year-old primary rhinoplasty patient presented with nasal airway obstruction and a pinched nasal tip caused by severely concave lateral crura and a narrow middle vault. Internal nasal examination revealed a narrow internal nasal valve angle with a straight septum.

The operative goals included the following:

- Correct the middle vault collapse.
- Correct the concave lateral crura and external valve collapse.



Using an open rhinoplasty approach, the nasal dorsum and the nasal tip was exposed, and septal cartilage was harvested. Spreader grafts were placed into the submucosal pockets between dorsal septum and upper lateral cartilages bilaterally. Lateral crural strut grafts approximately 25 by 5 mm were prepared from the thicker portion of the septum. Cephalic portions of lateral crura were resected leaving a 6 mm alar rim strip. The lateral crural strut grafts were placed on the undersurface of lateral crura and fixated to the lateral crura with three nonabsorbable sutures.

The patient is shown 1 year postoperatively. The narrow middle vault is widened, and internal nasal valve insufficiency has been improved. The pinched nasal tip and external nasal valve collapse have been corrected with the use of the lateral crural strut grafts. The nasal airway is improved significantly.

Convex Lateral Crura

Most boxy tip deformities can be corrected by placing horizontal mattress sutures from medial crus to lateral crus. The lateral crural mattress suture is also a useful technique in correcting the convexity of the lateral crura in the bulbous and boxy tip. However, these sutures may create a secondary deformity by displacing the lateral crus–accessory cartilage junction medially, compromising the nasal airway. Lateral crural strut grafts straighten the excessively convex lateral crura and are useful in preventing or correcting this potential problem.

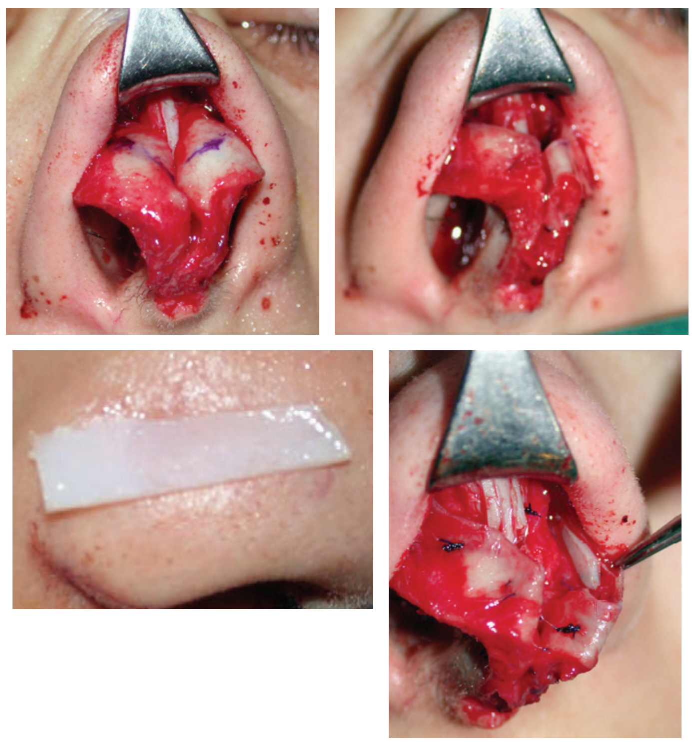
Case Analysis

This 22-year-old patient presented with an asymmetrical narrow dorsum and boxy nasal tip. Her lateral crura were convex with a medial angulation at their junction with the accessory cartilages, creating a supraalar notching deformity. She had a mild degree of cephalic malposition. Internal nasal examination revealed a narrow internal nasal valve with a deviated septum obstructing the airway.

The operative goals included the following:

- Correct septal deviation.
- Reduce the dorsal hump.
- Widen the narrow bony vault and narrow middle vault.
- Correct the boxy nasal tip and supraalar notching deformity.

Using the open rhinoplasty approach, septoplasty and septal cartilage harvest were performed. After 1 mm of dorsal reduction, medial oblique osteotomies with outfracturing were performed to create room for spreader grafts. Bilateral superiorly extended spreader grafts were placed to widen the dorsum and improve internal nasal valve function. Lateral osteotomies were not performed. Cephalic portions of lateral crura were resected, leaving a 7 mm alar rim strip and transdomal sutures were placed to correct the tip bulbosity.



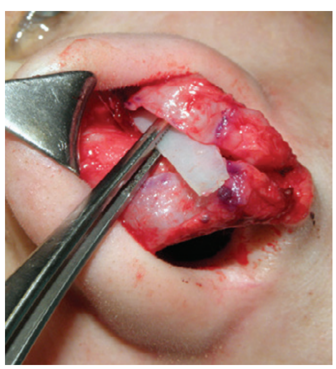
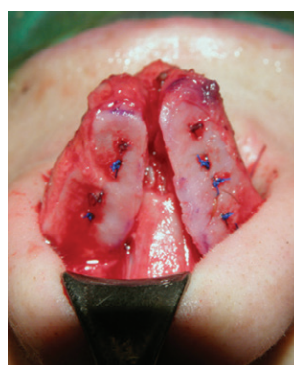
The modified lateral crural strut grafts along the undersurface of the lateral crura were placed bilaterally. The grafts were prepared wider laterally, to support alar rim and correct supraalar notching. The lateral end of the graft was placed caudal to the alar groove. A thin radix graft prepared from cephalic remnants of lateral crura was placed to augment radix.

The patient is shown 1 year postoperatively. The narrow bony vault and midvault are widened and internal nasal valve collapse has been corrected. A smooth, straight dorsum is achieved. The boxy nasal tip and supraalar notching is corrected with the use of modified lateral crural strut grafts.

Unusual and Asymmetrical Curvature Deformities of the Lateral Crura

Although the most common curvature deformities of the lateral crura are convex lateral crura and concave lateral crura, rare curvature deformities can be seen. In some patients the lateral crura shape can be congenitally asymmetrical. Most of these deformities are easy to correct with judicious use of lateral crural strut grafts.


In some patients, a portion of the lateral crus is convex, whereas other parts can be concave, creating an S-shaped curvature.

Lateral crural strut grafts are the most versatile method for correcting these deformities.

Lateral crural strut grafts are indicated for correction of concave lateral crura, a boxy tip, cephalic malposition of the lateral crura, alar rim retraction, and strengthening of weak lateral crura.

CEPHALIC MALPOSITION OF THE LATERAL CRURA

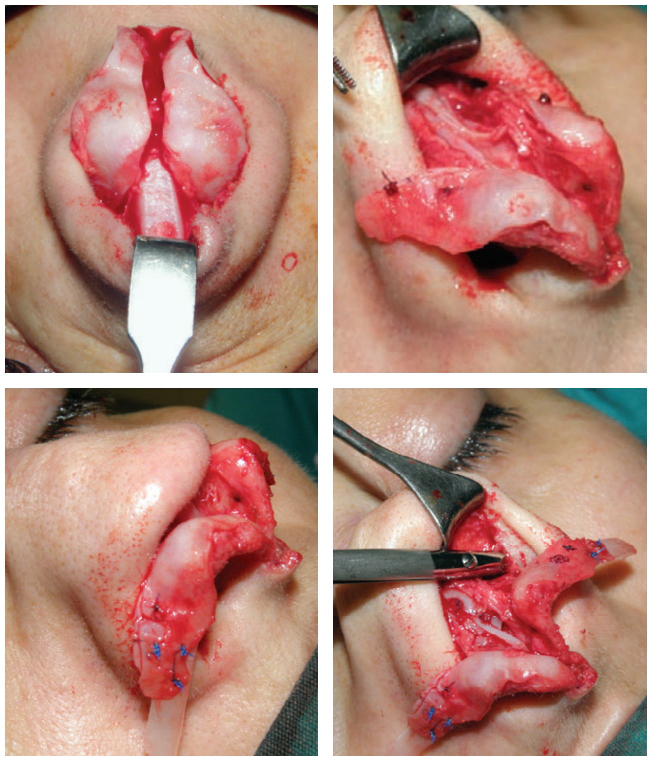
In cephalic malposition of the lateral crura, the lateral crus has a cephalic orientation and the alar rim is unsupported, causing a parenthesis deformity of the nasal tip. The malpositioned lateral crus does not parallel the alar rim. The degree of cephalic malposition may range from mild to severe. In mild and moderate malpositions, a modified lateral crural strut graft that is wider laterally can be placed parallel to the alar rim without caudal transposition of lateral crura. The graft supports the alar rim and corrects alar notching. In severe cephalic malpositions, lateral crural transposition is the method of treatment. In this technique, the malpositioned lateral crus is separated from the accessory cartilages and transposed caudally. If the lateral crus lacks length and/or strength, the lateral crus must be strengthened and elongated with a lateral crural strut graft for a predictable reconstruction. The lateral end of the graft is placed in a pocket undermined caudal to the accessory cartilages.

Case Analysis

This 43-year-old patient requested correction of her dorsal hump and the severe cephalic malposition of the lateral crura.

The operative goals included the following:

- Reduce the dorsal hump.
- Perform caudal transposition of the cephalic malpositioned lateral crura to improve the nasal tip.



The lateral crura were separated from the accessory cartilages. Lateral crural strut grafts created from septal cartilage were placed underneath the lateral crura, and the lateral crura were transposed caudally. The lateral end of the graft was placed in a pocket undermined caudal to the accessory cartilages.

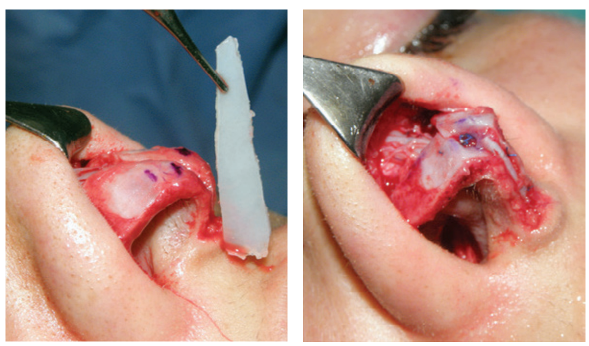
The patient is seen 9 months postoperatively. The malpositioned lateral crura have been corrected and the alar rims have adequate support.

WEAK LOWER LATERAL CARTILAGES

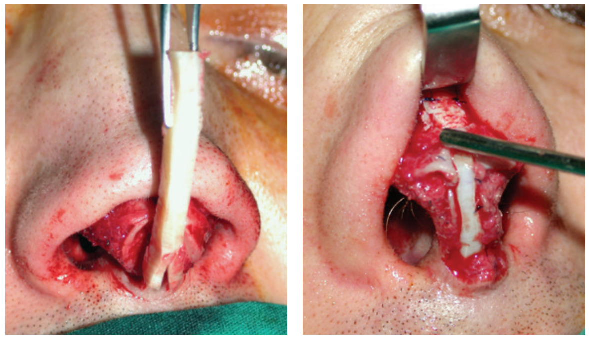
The length and strength of the medial crura is critical for tip projection and definition. Short, weak medial crura can lead to loss of supratip definition, because there is less of a differential between the dorsal height and the domal peaks.

Nasal tip definition is lost in patients with thin and weak lower lateral cartilages. This is particularly important in cases with thick nasal tip skin. The structural approach helps strengthen the weak cartilages and add definition to the nasal tip.

The columellar strut graft is probably the most often used graft in rhinoplasty. Columellar strut grafts strengthen the existing tip support, provide stability, and increase tip projection when the medial crura are advanced on it. The columellar strut graft is also useful in changing the columellar-lobular angle, controlling the length of the medial or middle crural segments and correcting intercrural deformities or asymmetries of the lateral crura.



If a significant increase in tip projection is needed, advancing the lateral crura medially with a spanning suture (lateral crural steal) and the simultaneous use of a long, strong columellar strut graft produce consistent results. Strong columellar strut grafts can be prepared from the thicker portions of the septal cartilage. In primary rhinoplasty patients who do not have strong septal cartilage and in secondary rhinoplasty patients without sufficient septal cartilage for harvest, the columellar strut graft can be fabricated from rib cartilage. Warping can be minimized by performing symmetrical balanced carving of the graft from the central core of the cartilage.

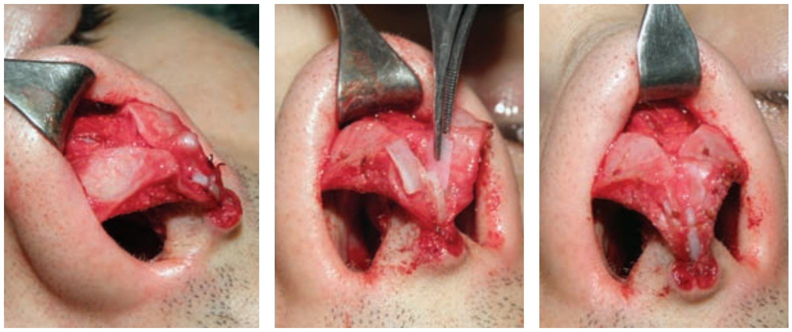


The columellar strut graft is placed between the medial crura, and the medial crura are advanced on the columellar strut graft with nonabsorbable sutures to achieve the desired tip projection. Long columellar strut grafts prepared from rib cartilage can be affixed to the anterior nasal spine for stability of the reconstruction.

After the columellar strut graft is placed, if additional increase in tip projection and further refinement are needed, a tip graft can be used to increase tip projection and improve tip contour. Shield-type tip grafts are particularly useful in patients with a short infratip lobule and in secondary cases.

Another effective method for increasing tip projection and adjusting tip position is the caudal septal extension graft. It is a rectangular graft placed caudal to the existing caudal septum and is stabilized with splinting grafts or distally extended spreader grafts. Then the medial crura are sutured to the caudal margin of the graft to achieve the desired tip projection and rotation.

If the lateral crura are congenitally weak, structural grafting should be considered. In the presence of a weak lateral crus, any surgical intervention may accentuate or cause external nasal valve collapse. In mild cases, a lateral crural turn-in flap can be used to support the lateral crus. Alar contour grafts are another method to reinforce the alar rim in cases of mild to moderate weakness of the lateral crura. The lateral crural strut graft is the most effective method for supporting a weak lateral crus, adding stability to the nostril rim and external nasal valve.



For narrow, weak domes, a subdomal graft can be placed in a pocket under the dome to strengthen and widen the domes. In rare cases of weak middle crura, a rectangular cartilage can be placed under the middle crura to buttress them.

Case Analyses

This 20-year-old woman presented with a dorsal hump, an underprojected tip, an acute nasolabial angle, and retracted alae. Her lateral crura were weak, alar

rims were not well supported and domes were weak and pointed. Internal nasal examination revealed a deviated septum obstructing the airway.

The operative goals included the following:

- Correct the septal deviation.
- Reduce the dorsal hump.
- Refine the dorsal aesthetic lines.
- Increase tip projection and improve the nasolabial angle.
- Support the weak domes and lateral crura.

Using the open rhinoplasty approach, septoplasty and septal cartilage harvest were performed. The bony and cartilaginous hump were reduced and medial oblique and lateral osteotomies were performed. Spreader flaps were used to establish the cartilaginous dorsum.

To increase tip projection, the lateral crura were advanced medially with spanning sutures. A long columellar strut graft was prepared from the harvested septum and the medial crura were advanced on the columellar strut graft with three sutures.

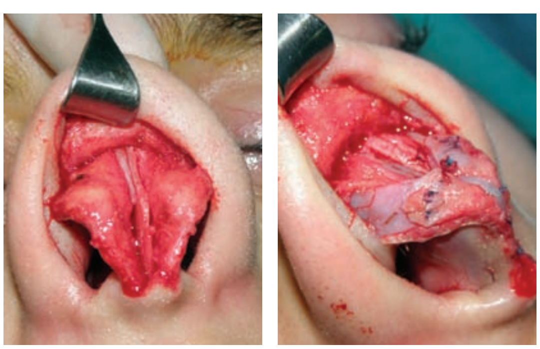
A subdomal graft was placed to reinforce and widen the weak domes. A thin onlay tip graft was placed for further increase in tip projection. Alar contour grafts were placed bilaterally to support alar rims.

The patient is shown 2 years postoperatively. Her dorsal hump was removed, and a smooth, straight dorsum has been achieved. Tip projection is increased, the nasal tip is well supported, and alar rim retraction has been corrected.

This 17-year-old patient with thick sebaceous skin requested refinement of her nasal tip. Her lower lateral cartilages were thin and soft.

The operative goals included the following:

- Reduce the dorsal hump.
- Refine the nasal tip.
- Strengthen the alar sidewalls.
- Increase tip projection and improve the nasolabial angle.
- Narrow the alar bases.



The nasal dorsum was exposed with the use of the open rhinoplasty approach. To increase tip projection, lateral crural steal with spanning sutures and advancement of media crura on a long columellar strut graft was performed. To elongate and strengthen the shortened lateral crura, the lateral crura were separated from the accessory cartilages, and lateral crural strut grafts were placed to fill in the gap between the accessory cartilages and the lateral end of the lower lateral cartilage.

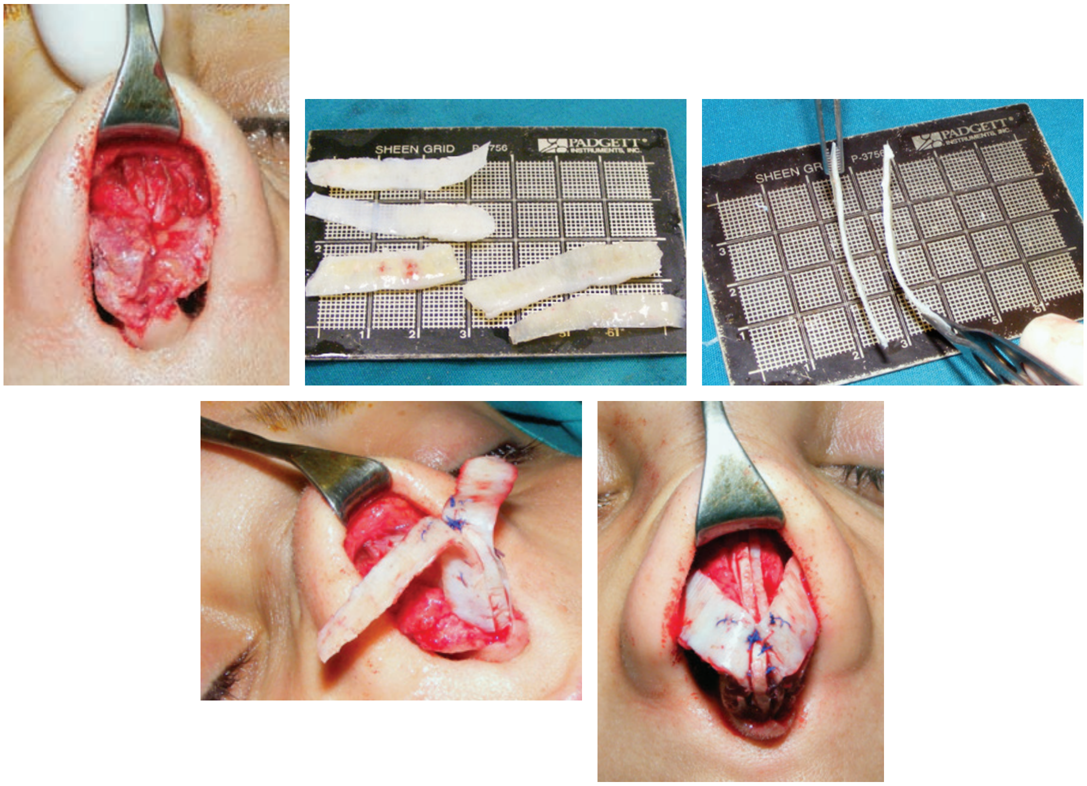
Minimal dorsal hump reduction, radix augmentation, and alar base reduction were also performed.

The patient is shown 6 months postoperatively. The nasal tip is refined, tip projection is increased, a straight dorsum has been achieved, and the alar base width is reduced.

This 23-year-old patient presented with a mild form of maxillonasal dysplasia (Binder's syndrome). She had low tip projection and underdeveloped, infantile lower lateral cartilages and septal cartilage.

The operative goals included the following:

- Reconstruct the septal L-strut.
- Reconstruct a structured nasal tip.



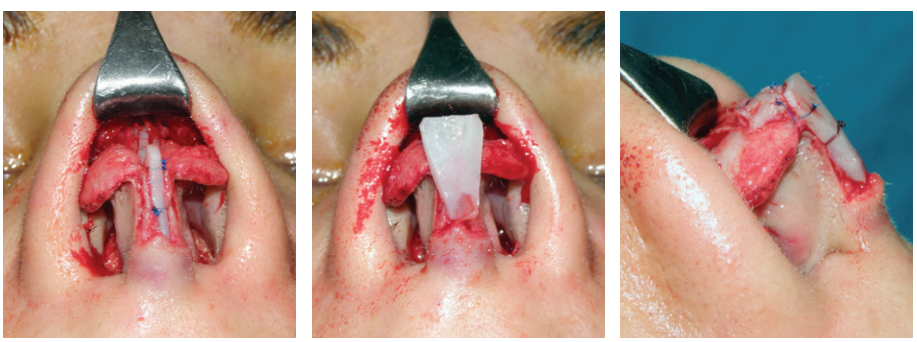
Cartilage from the sixth rib was harvested. Five cartilage strip grafts were prepared for septal L-strut reconstruction and lower lateral cartilage reconstruction. First, septal L-strut reconstruction was performed with placement of two struts dorsally and one strut caudally. The caudal strut was placed more caudally as a septal extension graft. Two long cartilage grafts were prepared for lower lateral cartilage reconstruction. These grafts were thinned to less than a millimeter of thickness to make them pliable. Medially the cartilage grafts were sutured to the caudal septal extension graft reconstructing the medial crura. The grafts were bent with spanning sutures using 5-0 nylon and new domes were created. The lateral segments of the grafts were kept long and were extended to the piriform aperture. The vestibular skin is then secured to the lateral crural grafts with 5-0 gut suture. A dome equalization suture was placed to approximate the grafts and to create dome-defining points.

The patient is shown 9 months after surgery. A structured approach allowed anatomic reconstruction of the nasal tip and the septum. Tip projection was increased significantly and the alar rims are well supported.

This 19-year-old patient presented with a dorsal hump, inadequate tip projection, short medial crura, weak alar rims, and a short infratip lobule. She had airway problems caused by her caudal septal deviation.

The operative goals included the following:

- Correct the septal deviation.
- Reduce the dorsal hump.
- Increase tip projection and lengthen the short infratip lobule.
- Support the weak domes and lateral crura.



Using the open rhinoplasty approach, septoplasty was performed with caudal septal relocation. The bony and cartilaginous hump were reduced and spreader flaps were used to restore the cartilaginous dorsum. The footplates were sutured the caudal septum. A long columellar strut graft was prepared from the harvested septum and the medial crura were advanced on the columellar strut graft with sutures. A shield-type tip graft was placed to increase tip projection and lengthen the infratip lobule. An onlay tip graft was placed at the cephalic aspect of the shield graft. Alar contour grafts were placed bilaterally to support the alar rims.

The patient is shown 2 years postoperatively. The dorsal hump was removed, the caudal septal deviation has been corrected, tip projection is increased, the infratip lobule is elongated, and the alar rims are well supported.

SHORT LOWER LATERAL CARTILAGES

Short lower lateral cartilages usually present with inadequate tip projection and ill-defined nasal tip contours. If the medial crura are short and lateral crura are long, the lateral crural steal procedure (advancing the lateral crura medially with spanning suture) can elongate the medial crura and increase tip projection. This technique is effective and useful in increasing tip projection and usually combined with the placement of a columellar strut graft for stability. The lateral crural steal technique rotates the nasal tip upward, augments the infratip lobule, and changes the columellar-lobular angle.

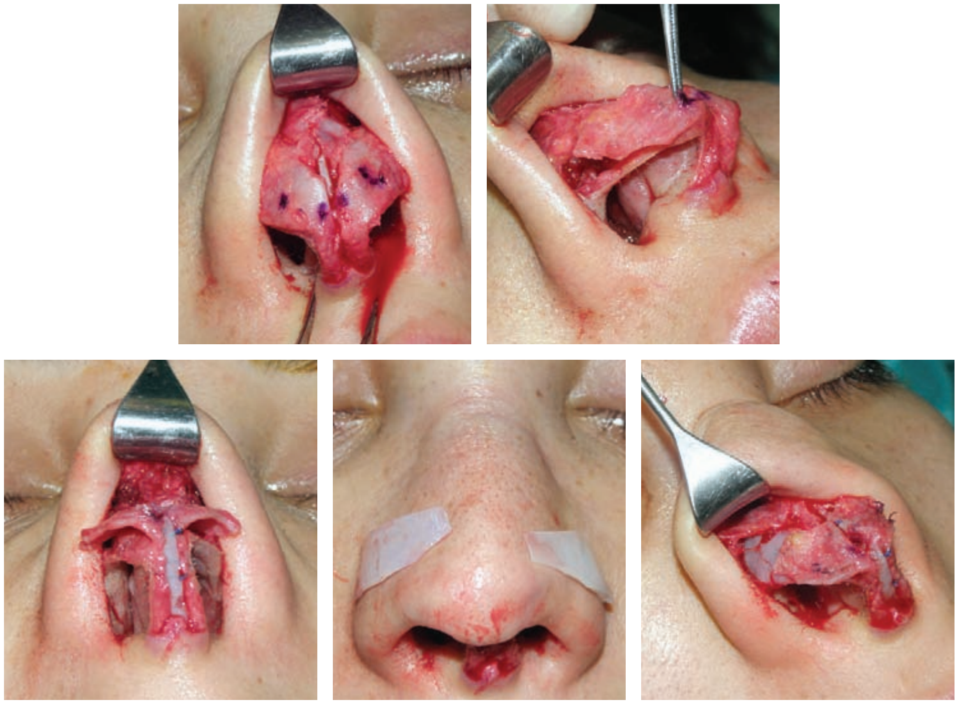
If the overall length of the lower lateral cartilages is short, the lateral crural steal technique will shorten the lateral crura further. In this case, the lateral crura can be divided from accessory cartilages to advance medially, and a lateral crural strut graft is placed between the lateral crura and the accessory cartilages to reconstitute a stable nasal tip tripod.

Case Analysis

This 19-year-old patient presented with a dorsal hump, inadequate tip projection, and an ill-defined nasal tip. Her medial crura were short and the footplates did not extend down to the nasal base. The lateral crura were weak, the alar rims were not well supported, and she had weak dome support.

The operative goals included the following:

- Reduce the dorsal hump.
- Increase tip projection and improve the nasolabial angle.
- Support the weak alar sidewalls.



Using the open rhinoplasty approach, the nasal dorsum and nasal tip were exposed. After harvesting the septal cartilage, the bony and cartilaginous hump was removed. Spreader flaps were used to establish the cartilaginous dorsal width. The medial crura were separated and the caudal septum was exposed down to the anterior nasal spine. The anterior nasal spine was reduced. A transfixing suture was placed to set back the medial crura on the caudal septum. The lateral crura were divided from the accessory cartilage junctions. The lateral crura were advanced 5 mm medially with spanning sutures (lateral crural steal). A long columellar strut graft was placed between the medial crura to increase tip projection. Lateral crural strut grafts were placed on both sides between the lateral crura and the accessory cartilage to reconstitute a stable nasal tip tripod.

The patient is shown 1 year postoperatively. The dorsal hump is gone, tip projection is increased, the medial crura are set back to the nasal base, the short medial crura are lengthened, the nasal tip is well supported, and the alar rim retraction has been corrected.

CONGENITAL DEFORMITIES OF THE LOWER LATERAL CARTILAGES


Congenital asymmetries or the absence of lower lateral cartilages can be corrected with structural grafting principles. Lateral crural strut grafts can be used to correct lateral crural asymmetries. In the absence of lateral crura, a lateral crural graft can be placed to replace the missing segment. If available, septal cartilage is the graft material of choice in these cases.

SECONDARY DEFORMITIES OF THE LOWER LATERAL CARTILAGES

If the principles of structural rhinoplasty are not taken into consideration at the time of primary rhinoplasty, there usually is a loss of the tip-supporting mechanisms. Excessive removal of the tip cartilages and inadvertent use of sutures further accentuates the problem. The septal integrity may be lost, and this increases tip-support problems. There may be asymmetries, and functional issues may accompany these deformities.

In secondary rhinoplasty, reconstruction of the nasal framework to produce an aesthetic and functional improvement should be the goal. Following structural rhinoplasty principles, functional deformities are treated to give a more normal and balanced nasal shape, reestablish nasal support, restore tip projection, and treat the nasal airway problems. A variety of structural grafts may be required to achieve these goals. A stable and straight septal cartilage is essential for tip support, and septal reconstruction should precede any tip reconstruction.

Anatomic reconstruction of the weakened or interrupted lower lateral cartilages and reconstitution of a stable nasal tip tripod must be performed for a predictable outcome. The newly reconstructed cartilaginous framework should be strong enough to withstand the even greater forces of scar contraction during the healing period.

In secondary cases, anatomic reconstruction of the weakened or interrupted lower lateral cartilages and reconstitution of a stable nasal tip tripod must be performed for a predictable outcome.

ESTABLISHING TIP PROJECTION AND POSITION

An accurately positioned and stable nasal tip is essential for a successful rhinoplasty. In secondary cases with an overresected nasal skeleton, tip projection is usually lost and has to be reestablished. Structural grafts for tip projection include the columellar strut graft, the caudal septal extension graft, and tip grafts. With increase in tip projection, a higher dorsum is required, which helps to create a narrower appearance in wide noses. This is particularly important for patients with thick skin and overresected nasal cartilages. The typical pollybeak deformity caused by an overresected nasal skeleton can be corrected by adjusting the tip projection. In the majority of secondary cases in which the nasal skeleton has been overresected, dorsal augmentation is needed after nasal tip projection is increased.

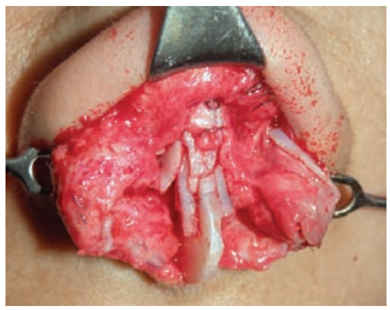
In secondary cases with an overresected nasal skeleton, tip projection is usually lost and has to be reestablished. Tip projection can be achieved with a columellar strut graft, caudal septal extension graft, or tip grafts.

Columellar Strut Graft

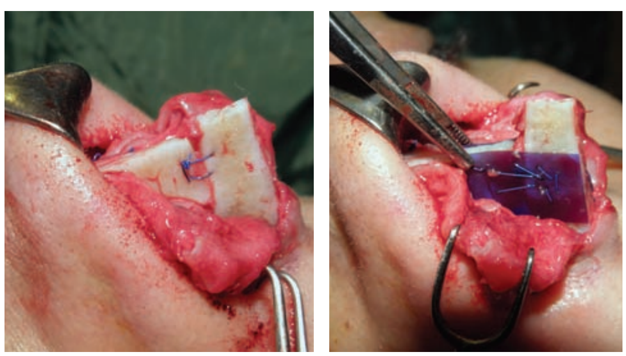
The columellar strut graft is the most versatile and powerful tool to stabilize the columellar base, strengthen the weak medial and middle crura, increase tip projection, and change tip rotation. It is placed in a pocket between medial and middle crura, keeping a bed of soft tissue between the graft and the anterior nasal spine. If an increase in tip projection is needed, longer and stronger columellar strut grafts are used and the medial crura are advanced on the columellar strut graft. In this case, the columellar strut graft is placed in the pocket and the medial crura are pulled upward in the direction of desired tip rotation and projection. Needles are passed through the medial crura and the strut to judge whether the desired effect is obtained and the strut is then fixated with 5-0 nonabsorbable nylon sutures to the medial crura.

The columellar strut graft is a very useful tool for stabilizing the columellar base and correcting medial crural deformities. A long and strong columellar strut graft can be used to increase tip projection by advancing medial crura on it.

Caudal Septal Extension Graft

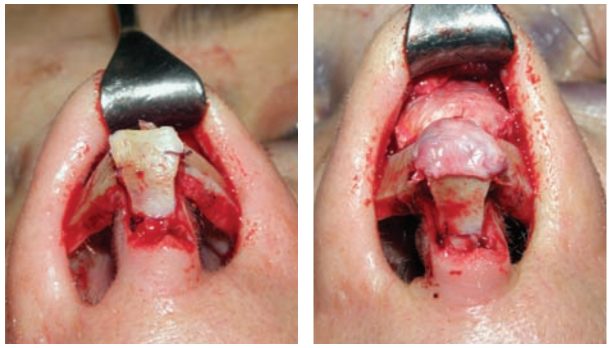


A caudal septal extension graft is a rectangular cartilage that is extended off the caudal septum and sutured between the medial crura. It is a useful tool for setting the projection and rotation of the nasal tip. To maximize stability and avoid asymmetries, it should be stabilized to the existing caudal septum with bilateral spreader grafts.



As for fixation of the columellar strut graft, needles are passed through the medial crura and septal extension graft to judge the position of the tip, and then the medial crura are fixated to the septal extension graft. If the caudal septal extension graft is prepared from rib cartilage, it can be stabilized to the caudal septum with PDS plates to avoid extra thickness of the columella.

Tip Grafts



Tip grafts can be used to increase tip projection and improve tip contour. In revision cases, shield-shaped tip grafts are preferred to achieve tip definition and hide tip asymmetries. If the shield graft is prepared from rib cartilage, visibility of the sharp edges of the cartilage can be a problem in the long term; hence these grafts are camouflaged using fascia or perichondrial grafts.

Tip grafts can be used to increase tip projection and improve tip contour. In secondary cases, shield-shaped tip grafts are preferred to achieve tip definition and hide tip asymmetries. The sharp edges of the cartilage can be camouflaged using fascia or perichondrial grafts.

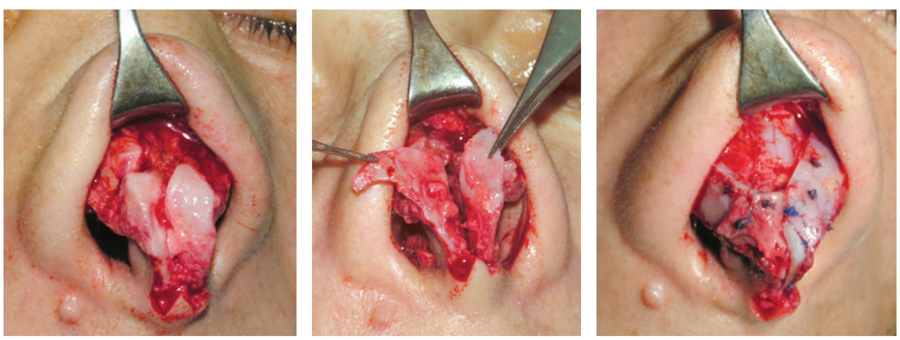
Lateral Crural Reconstruction

Overzealous resection of the lateral crura may result in alar rim collapse because of severe attenuation or interruption of the alar rim strip. Patients usually present with narrow nostrils and a pinched tip deformity. In many cases, nasal airway obstruction resulting from external nasal valve collapse accompany this deformity. Internal nasal valves might also be affected.

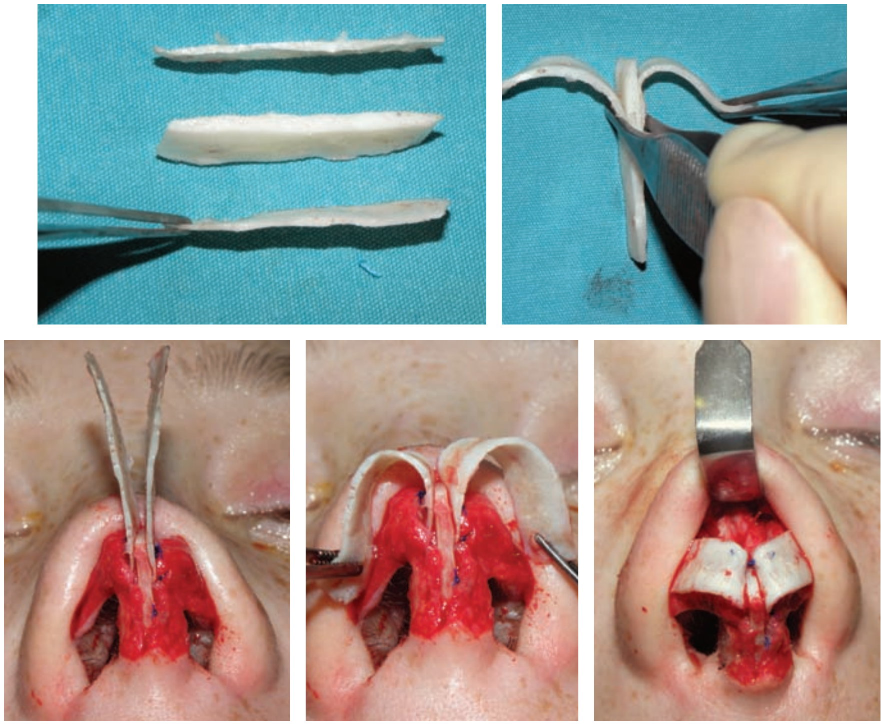
Weak, misshapen, malpositioned, or segmentally deficient lateral crura must be reconstructed to achieve a stable nasal tip tripod for an aesthetically pleasing outcome and functioning external and internal nasal valves. The lateral crural graft is a versatile tool for reshaping, repositioning, or replacing the missing segments of the lateral crura. The grafts can be prepared from septal, auricular, or rib cartilage.

The lateral crural graft is a versatile tool for reshaping, repositioning, or replacing the missing segments of the lateral crura and domes.

If the deformity is not severe, such as attenuated lateral crura or a missing small segment, replacing or strengthening the deformed segment with a lateral crural graft is the preferred method of reconstruction to establish the shape and stability of the lateral crura.



If the lateral crura are missing but the medial crura and domes are intact, the vestibular skin is dissected off the undersurface of each dome to fixate lateral crural grafts. Long lateral crural grafts, prepared from septal or rib cartilage, are then sutured to the undersurface of each dome to replace the missing lateral crura. The grafts are kept long enough to extend laterally to the piriform aperture.



If the domes and lateral crura are missing or severely deformed, a columellar strut graft is placed to reconstruct the caudal leg of the tripod and it is fixated to the medial crural remnants. Long lateral crural grafts are prepared from the rib cartilage (usually the length of the septal cartilage is insufficient) and thinned, to allow the graft to bend.

The lateral crural grafts are fixated to the columellar strut graft with two sutures about 4 to 5 mm below the upper end of the columellar strut graft. Then the lateral crural grafts are bent and domes are created with dome spanning sutures. The newly created domes are approximated with a dome equalization suture. This suture helps create two tip-defining points and supratip break point.

Long lateral crural grafts can be prepared from rib cartilage and thinned, allowing the graft to bend and be used to reconstruct the missing domes and the lateral crura.

In some patients and the elderly, the rib cartilage is more calcified and rigid, and it is not usually possible to carve thin lateral crural grafts that are pliable enough to create new domes with spanning sutures. In these cases, the lateral crural grafts are sutured to the tip of the columellar strut to reconstitute the nasal tip tripod. The grafts are extended laterally to the piriform aperture. The angle between columellar strut and lateral crural graft is kept at approximately 45 degrees.

To preserve this angle and for the stability of the lateral crural graft–columellar strut graft junction, small triangular cartilage grafts can be placed between the lateral crural grafts and the columellar strut graft just underneath the suture line

To create the tip-defining points and camouflage the sharp edges of the columellar strut graft and lateral crural grafts, a tip graft can be placed on top of the junction.

To camouflage the sharp edges of the tip graft, an onlay rectus fascia graft or a perichondrial graft is placed on the newly reconstructed dome.

Case Analyses

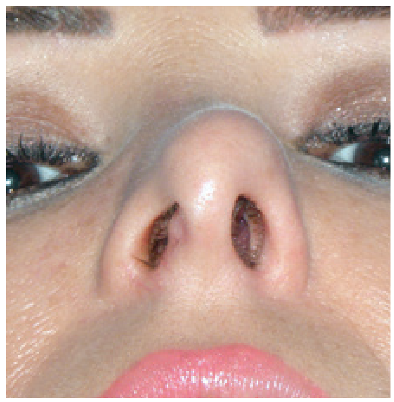
After one prior rhinoplasty, this 26-year-old woman presented with low tip projection, a pollybeak deformity, an inverted-V deformity, and functional nasal problems. Both lateral crura were missing, and she had weak medial crural remnants.

The operative goals included the following:

- Refine the dorsal aesthetic lines.
- Correct the inverted-V deformity and improve the internal nasal valves.
- Reduce the dorsal hump.
- Correct the pollybeak deformity.
- Increase tip projection and improve the columellar-lobular angle.
- Reconstruct the missing lateral crura.

Sixth rib cartilage was harvested. Bilateral spreader grafts were placed to reconstruct the internal nasal valves. A long columellar strut graft was placed between the medial crural remnants. The lateral crural grafts were sutured to the tip of the columellar strut graft. A shield-type tip graft was used to achieve extra projection. A piece of rectus abdominis fascia was placed to smooth the sharp edges of tip graft. A thin, diced cartilage–rectus abdominis fascia graft was placed to camouflage dorsal irregularities.

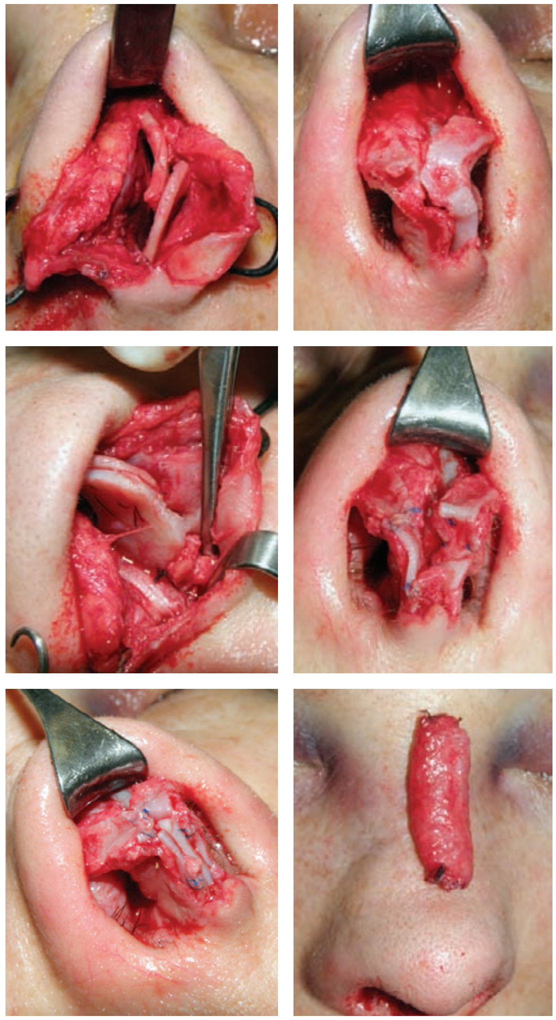
The patient is shown 18 months after surgery. The nasal tip projection is increased and a structured nasal tip has been achieved, with functional improvement. The inverted-V deformity is corrected and the nasal dorsum is smooth.



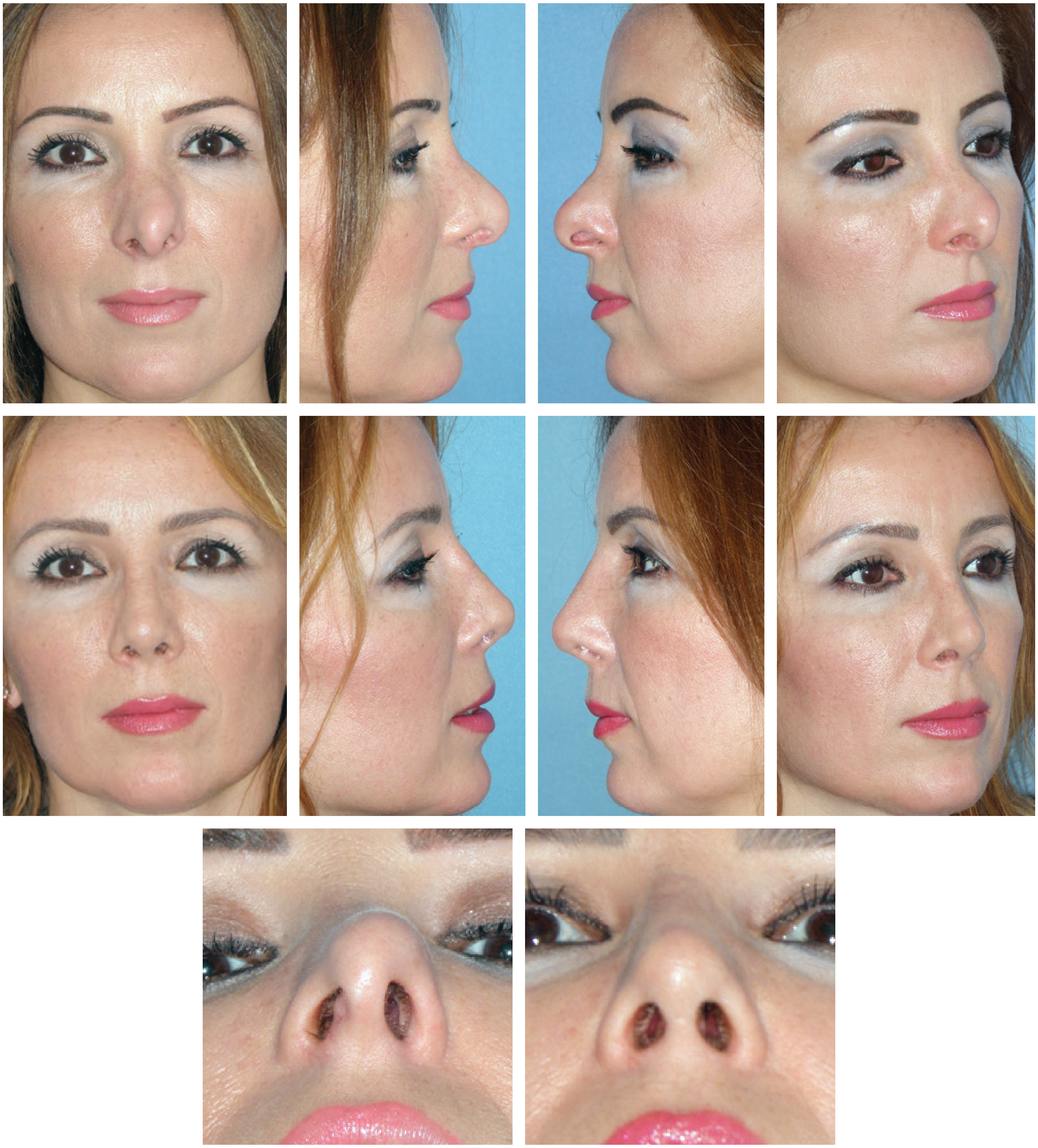
After one prior rhinoplasty, this 38-year-old patient presented with tip asymmetry, a hanging columella, an overresected dorsum, septal deviation, and functional problems. On the right side, a segment of the middle crura was missing. Septal cartilage remained untouched after the primary surgery but was severely deviated.

The operative goals included the following:

- Refine and augment the nasal dorsum.
- Correct the septal deviation and reconstruct a straight, stable septal L-strut.
- Correct the hanging columella and support the medial and middle crura.
- Reconstruct the missing segments of the lower lateral cartilages and correct tip asymmetry.
- Support the alar rims.



An extracorporeal septoplasty was performed and a septal-L strut was reconstructed from the septal cartilage. It was secured to the anterior nasal spine caudally and to the nasal bones and upper lateral cartilage remnants cephalically. The missing right middle crura was reconstructed with a septal cartilage graft. A columellar strut graft was used to stabilize the medial crura. Bilateral alar contour grafts were placed to reinforce the alar rims. A diced cartilage–fascia graft was placed to augment the dorsum and camouflage the dorsal irregularities.



The patient is shown 2 years postoperatively. Tip asymmetry and the hanging columella have been corrected, and a straight septum was achieved, with functional improvement. The nasal dorsum was augmented and the dorsum is straight and smooth.

COMPLICATIONS

Tip asymmetries can occur as a result of uneven placement of structural grafts. The surgeon must exercise care in placing the grafts symmetrically.

If a columellar strut graft is placed directly against the premaxilla, displacement from the midline can be seen postoperatively. If the columellar strut graft overlaps the caudal septum, shifting from the midline can be seen. If a soft tissue pad is not protected between the columellar strut graft and the anterior nasal spine, the patient can experience a clicking sensation while smiling.

Caudal septal extension grafts can cause deviation of the nasal tip if stabilized in an overlapping fashion to the caudal septum. To avoid this, the caudal septal graft is aligned end to end with the existing caudal septum using splinting grafts.

Lateral crural strut grafts may displace the vestibular skin medially and compromise the airway if they are not extended to the piriform aperture. Lateral crural strut grafts prepared from rib cartilage must be thinned enough to avoid this problem. If structural grafts for lower lateral cartilage reconstruction are thick, the thickness of the grafts may create bulk around the tip. This is particularly true for grafts prepared from rib cartilage.

CONCLUSION

A stable, well-structured nasal tip is essential for functional and aesthetic purposes. Short and weak medial crura usually present with an underprojected tip. The columellar strut graft is an effective and commonly used method for strengthening the medial crura and improving the tip support. If an increase of tip projection is needed, the medial crura can be advanced on a long and strong columellar strut graft or caudal septal extension graft. For a further increase in tip projection and for improvement of tip contour, shield-shaped or onlay tip grafts can be used.

Asymmetries and congenital malformations of the lower lateral cartilages can be corrected with the use of a variety of structural grafts. Lateral crural strut grafts are versatile tools in correcting curvature deformities of lateral crura, malposition of the lateral crura, and reinforcement of weak lateral crura.

In secondary rhinoplasty, reconstruction of the nasal framework to produce an aesthetic and functional improvement should be the goal. A variety of structural grafts may be required to achieve these goals. Anatomic reconstruction of weak-

ened or interrupted lower lateral cartilages and reconstitution of a stable nasal tip tripod must be performed for a predictable outcome. The newly reconstructed cartilaginous framework should be strong enough to withstand the even greater forces of scar contraction during the healing period.

KEY POINTS

- The lower third of the nose has a tripod-like support structure that is made up of the conjoined medial crura and lateral crural complex based bilaterally on the piriform aperture. Reconstructing a stable tripod structure supports the nasal tip, strengthens the alar sidewalls, and provides an aesthetically pleasing nasal tip.
- Preserving or reconstituting the structural nasal framework is essential for consistent and successful long-term results.
- The open rhinoplasty approach provides better visualization without distortion of cartilages, leading to accurate diagnosis and treatment.
- Autologous cartilage grafting is the preferred treatment, if structural grafting of the tip cartilages is considered. If available, septal cartilage is the graft of choice for autologous cartilage grafting.
- If significant support is required, autologous rib cartilage is the graft of choice. Long, straight struts can be prepared from rib cartilage for reinforcement or reconstruction of the lateral crural complex.
- Lateral crural strut grafts are indicated for correction of concave lateral crura, a boxy tip, cephalic malposition of the lateral crura, alar rim retraction, and strengthening of weak lateral crura.
- In secondary cases, anatomic reconstruction of the weakened or interrupted lower lateral cartilages and reconstitution of a stable nasal tip tripod must be performed for a predictable outcome.
- In secondary cases with an overresected nasal skeleton, tip projection is usually lost and has to be reestablished. Tip projection can be achieved with a columellar strut graft, caudal septal extension graft, or tip grafts.
- The columellar strut graft is a very useful tool for stabilizing the columellar base and correcting medial crural deformities. A long and strong columellar strut graft can be used to increase tip projection by advancing medial crura on it.
- Tip grafts can be used to increase tip projection and improve tip contour. In secondary cases, shield-shaped tip grafts are preferred to achieve tip definition and hide tip asymmetries. The sharp edges of the cartilage can be camouflaged using fascia or perichondrial grafts.
- The lateral crural graft is a versatile tool for reshaping, repositioning, or replacing the missing segments of the lateral crura and domes.
- Long lateral crural grafts can be prepared from rib cartilage and thinned, allowing the graft to bend and be used to reconstruct the missing domes and the lateral crura.

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21

A Predictable and Algorithmic Approach to Tip Refinement and Projection

Rod J. Rohrich ▪ Jeffrey E. Janis ▪ Ashkan Ghavami ▪ Jamil Ahmad

Attaining a well-defined and properly projecting nasal tip is vital to success in rhinoplasty. A thorough understanding of the anatomic structures that provide nasal tip support and their influences on tip projection and shape is critical for the proper diagnosis and treatment of intricate nasal tip deformities.

The following factors help to determine tip projection[1-6]:

- Length and strength of the lower lateral cartilages
- Length and stability of the medial crura and middle crura
- Suspensory ligament that spans the crura over the anterior septal angle of the upper and lower lateral cartilages
- Fibrous connections between the upper and lower lateral cartilages
- Abutment with the piriform aperture
- Anterior septal angle
- Skin and soft tissue thickness and availability

The length, strength, shape, and position of the lower lateral cartilages as well as the fibrous/ligamentous attachments between these paired structures play a central role in supporting the nasal tip.[1-6] The upper lateral cartilages, nasal septum, nasal base, and piriform aperture provide additional stability and support to the nasal tip through their soft tissue attachments.[1-11]

Ultimately, tip projection and definition are determined by the dynamic interplay between the aforementioned tip-supporting structures and the overlying skin and soft tissue envelope. Since the relative contribution of each structure in tip projection varies from one patient to another, all tip-supporting components should be critically assessed and the treatment plan individualized.

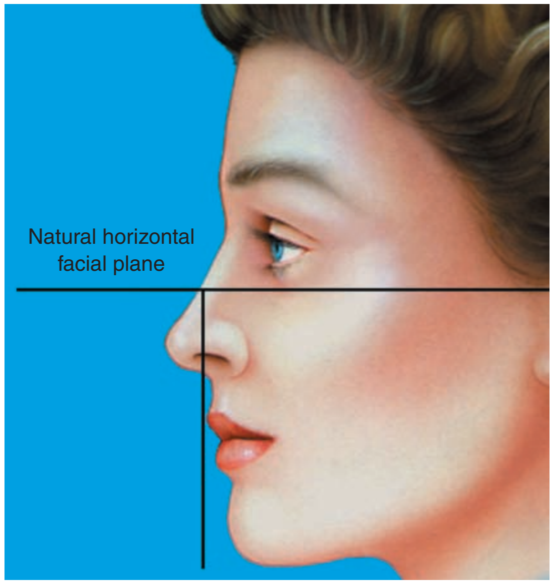
Preoperatively, an underprojecting nasal tip may be diagnosed as the primary nasal deformity or may accompany other nasofacial imbalances. Iatrogenic loss of tip support may result from purposeful or unintended violation of critical tip-supporting structures.[8,9] Maneuvers such as cephalic trim of the lower lateral cartilages, caudal septal resection, dorsal reduction, transfixion incisions, and alar base resections affect tip support and can cause a substantial reduction in tip projection.[1,5,12] The open approach can also lead to a small reduction in tip projection through disruption of skin and soft tissue supports.[13]

Over the past two decades, conventional destructive and irreversible tip modification techniques such as cartilaginous resection, transection, morselization, and scoring have been replaced by nondestructive, reversible, incremental, and dynamic tip-suturing techniques.* The popularity of visible/palpable cartilage grafts placed in a subcutaneous pocket underneath nasal skin has declined in recent years in favor of invisible/nonpalpable grafts placed within or underneath the cartilaginous framework.†

PREOPERATIVE ASSESSMENT AND PLANNING

Accurate diagnosis of the nasal deformity and understanding the patient's expectations are the initial essential steps to a successful outcome. Patients may desire simple tip refinement but may not understand the dynamic relationships between the upper, middle, and lower nasal thirds and the resultant effects of these relationships on overall nasal shape and balance.[29] Therefore patient education plays an important role. Performing a comprehensive nasofacial analysis will allow the detection of both prominent and subtle factors that contribute to the nasal tip deformity and will assist the surgeon in developing a treatment plan directed at each specific component. In addition, meticulous surgical technique, frequent intraoperative reassessment, and proper postoperative management all contribute to a successful outcome.

*References 3, 4, 11, 12, 14-26.
†References 4, 12, 13, 15, 27, 28.



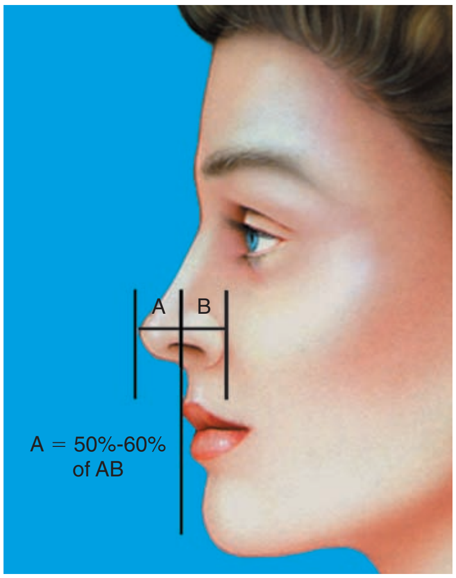
Comprehensive nasofacial analysis should include evaluation of the lip-chin complex.[30] Byrd and Hobar[31] suggested establishing a *nose-lip-chin plane* (NLCP), with ideal chin projection (in females) defined as 3 mm posterior to a plumb line drawn perpendicular to the natural horizontal Frankfort plane. The appearance of ideal tip projection depends on this relationship, because an underprojected chin will make the nasal tip seem overprojected, and vice versa.[30]

The appearance of ideal tip projection is dependent on the relationship of the nose-lip-chin complex, because an underprojected chin will make the nasal tip seem overprojected, and vice versa.

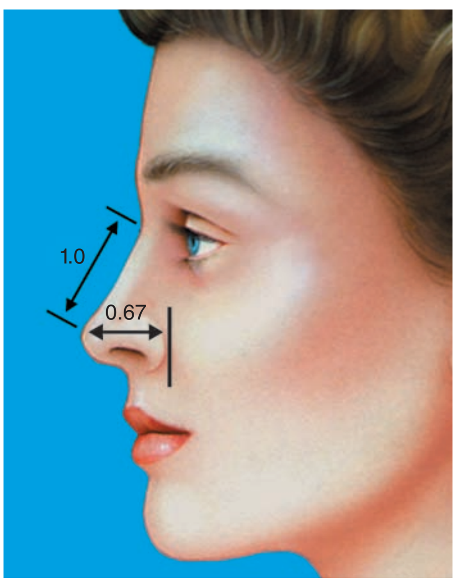
The thickness and sebaceous character of the nasal skin should also be evaluated. Males and certain ethnic subgroups such as those of black, Mediterranean, Hispanic, and Middle Eastern descent tend to have thicker, more sebaceous skin.[32-35] The thicker skin envelope may camouflage the results of tip modification, so more aggressive maneuvers in these patients may be necessary to achieve the desired result.[33-35] However, the need for more aggressive techniques to obtain an increase in tip projection, definition, or nasal length must be balanced with the limitations of stretching the skin envelope, because an iatrogenic tension tip may be produced that can lead to vascular compromise and skin loss in severe cases.[36]

In a patient with thick, sebaceous skin, alterations to the cartilaginous framework may need to be more aggressive to produce adequate tip definition and projection.

Next, attention is turned toward proportional nasal analysis, which has been thoroughly described previously.[37,38] Tip definition is best assessed on the frontal and basal views.[39,40] The presence of domal asymmetry, tip morphology (boxy or bulbous tip), the degree of nostril show, columellar excess, caudal septal deviation, and a hanging (static) or hyperdynamic (animated) tip are noted. Animated views should be obtained to diagnose depressor septi nasi muscle hyperactivity resulting in hyperdynamic tip ptosis.[41]



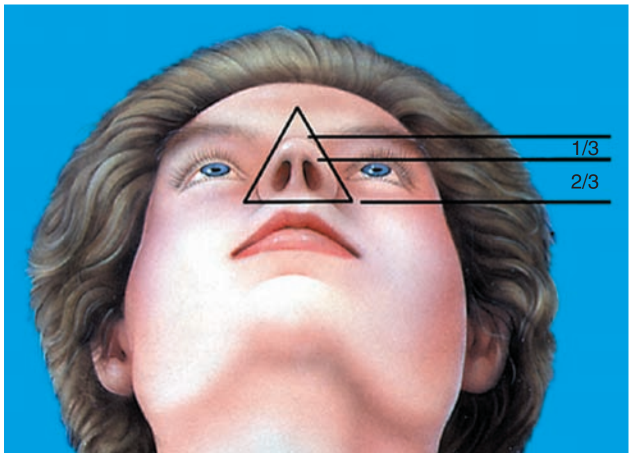
Tip projection is best assessed on the lateral view; it is evaluated by determining the proportion of the tip that lies anterior to a vertical line drawn adjacent to the most projecting part of the upper lip. Fifty percent to 60% of the tip should lie anterior to this vertical line. If less than 50% of the tip projects anterior to this reference line, the tip is underprojected.



Tip projection can also be measured as 0.67 times the ideal nasal length.[31]

Adequate tip projection is defined as the presence of 50% to 60% of the tip lying anterior to the most projecting point of the upper lip.

The nasolabial angle and alar-columellar relationship should be evaluated using previously established criteria, and are also best evaluated on the lateral view.[37,38] Maneuvers that increase tip projection will frequently affect the nasolabial and columellar-labial angles.

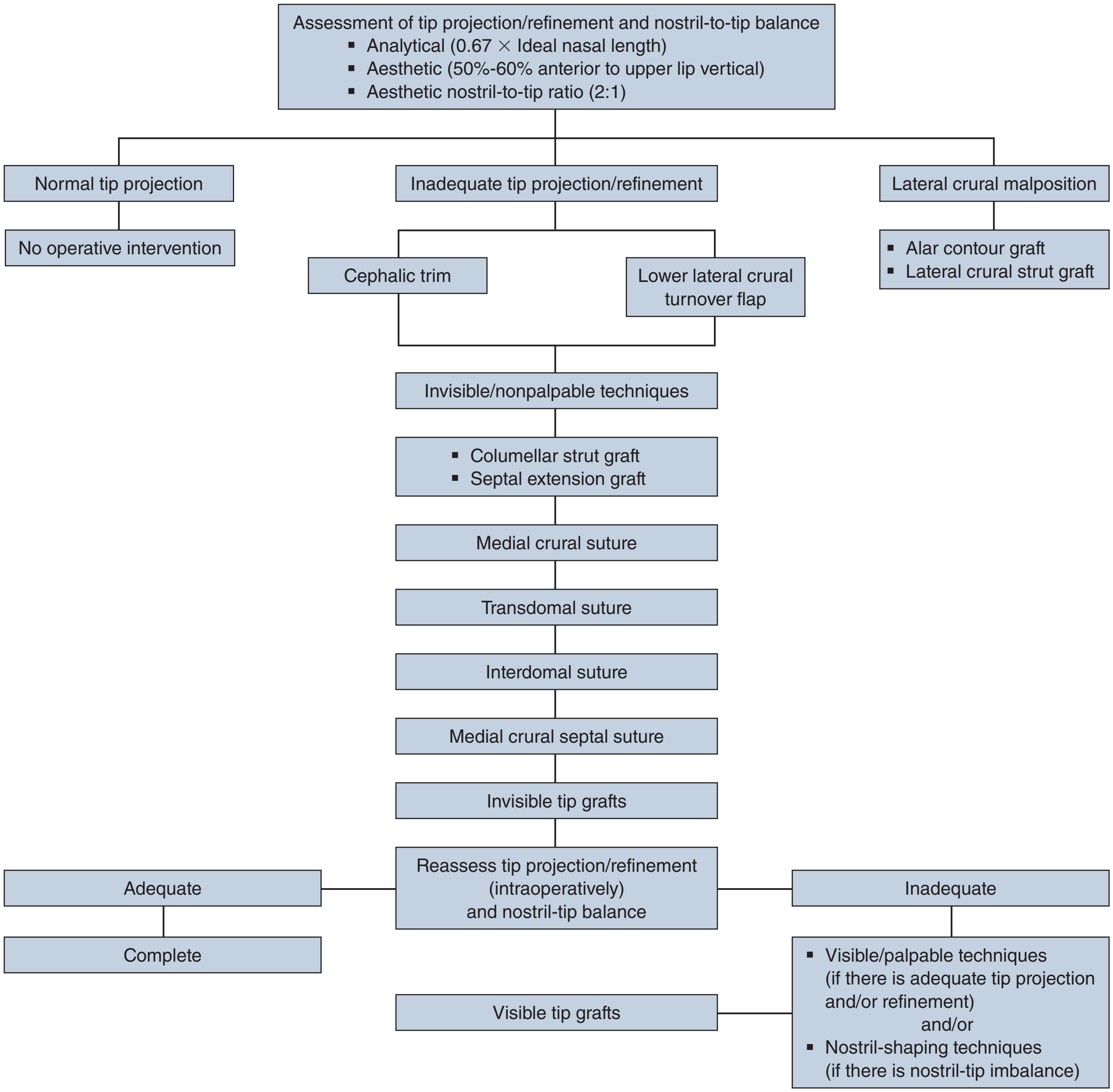


Nostril-tip proportion should be evaluated on the basal view. The ideal nostril-tip relationship should be approximately 2:1.[39] An imbalance can produce either an illusionary or a true nostril-tip disproportion, with tip overprojection if the nostrils are short and an insufficient nasal tip if the nostrils are long.[39,42]

Inadequate tip projection may manifest in a number of clinical scenarios. The inadequately projected tip may demonstrate increased alar flare, a short columella, or incorrectly shaped and inclined lower lateral cartilages.

After a systematic nasal analysis, surgical goals are established, and the plan is reviewed with the patient.

MANAGEMENT ALGORITHM



Our algorithmic approach for tip refinement and increasing projection is outlined above. Although tip sutures and other maneuvers in rhinoplasty can produce a multitude of dynamic changes, only those that pertain to nasal tip projection and tip refinement will be described.

Invisible/Nonpalpable Techniques That Influence Tip Refinement and Projection

Technique	Tip Refinement	Tip Projections
Cephalic trim	+	↓
Columellar strut graft	+	↑
Septal extension graft	+	↑
Medial crural suture	+	↑/↓
Transdomal suture	+	↑
Interdomal suture	±	↑/↓
Medial crural septal suture	+	↑/↓
Alar base resection	Neutral	↓

Approach

If minimal modifications of the nasal tip are required, the closed approach with cartilage delivery may be used. If a closed approach is used, great care should be taken to preserve existing anatomic integrity and soft tissue attachments of tip-supporting structures. For example, a Killian incision instead of a hemitransfixion or full transfixion incision may help preserve some soft tissue attachments that support the nasal tip. For major modifications of the nasal tip, including middle vault alterations and all secondary rhinoplasties, we prefer the open approach: it allows direct visualization and accurate assessment of all tip-supporting structures, and it facilitates precise, controlled, predictable maneuvers.

Great care should be taken to preserve or restore the anatomic integrity of the tip-supporting structures.

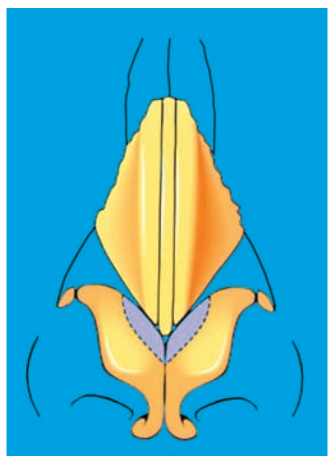
Intraoperative Analysis

Each element responsible for tip support is analyzed after adequate exposure. The lower lateral cartilages are assessed for any subtle asymmetries and contour irregularities. The degree of the convexity/concavity, length/width dimensions, position, rotational orientation, and symmetry are closely inspected. Analysis of the length of the medial crura is critical for tip projection and definition. Medial crura that are long and stable are less likely to contribute to loss of tip projection postoperatively. Short and/or weak medial crura can lead to a loss of supratip definition as a result of a decrease in the differential between dorsal height and domal peak.[40]

The domes are characterized in terms of the domal arch width, angle of divergence, and the degree of symmetry.[23,43] It is important to relate the lateral, middle, and medial crura together in the analysis because modifications made to one will commonly affect the others.[3,26] For example, reducing the vertical height of the domes using an extended cephalic trim will drop the supratip break on frontal view and enhance tip definition, and improperly stabilized medial crura will result in loss of tip projection and blunting of the supratip break, which eventually produces a pollybeak deformity.[36,40,44] It is important to note that at each point along the algorithm where surgical maneuvers are performed, the effect of each technique should be reassessed.

Manipulation of Lateral Crura

Cephalic Trim

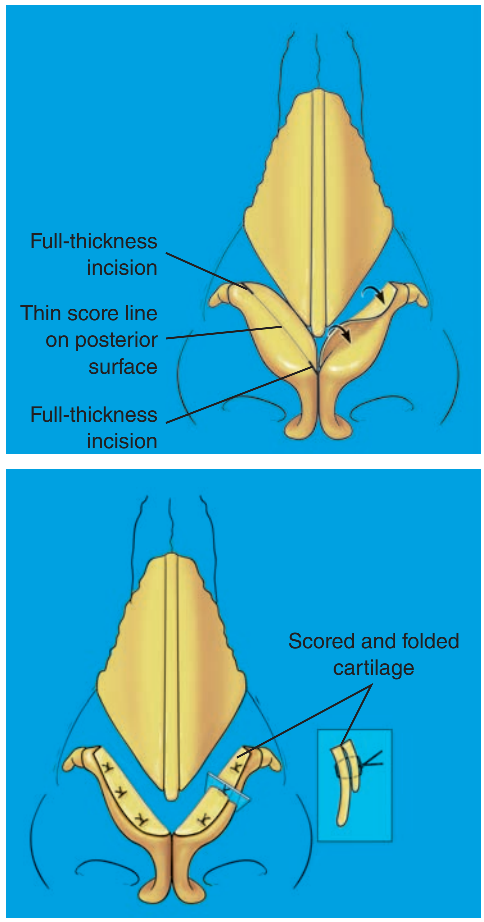


Only when the domes are bulbous or boxy, causing paradomal fullness, is a cephalic trim indicated. It is important to realize that cephalic trim intrinsically decreases tip support by disrupting attachments of the upper and lower lateral cartilages at the scroll area. However, cephalic trim is often a necessary maneuver to facilitate tip refinement with suture techniques.

The cephalic portion of the middle and lateral crura is detached from the underlying mucosa and excised leaving at least a 6 mm alar rim strip. Calipers are used to accurately measure the planned incision. Preserving strong lower lateral cartilages is particularly important when applying tip-suturing techniques that recruit the lower lateral cartilages to enhance the domal shape and height. For instance, transdomal, and to a lesser degree interdomal sutures, medialize the lower

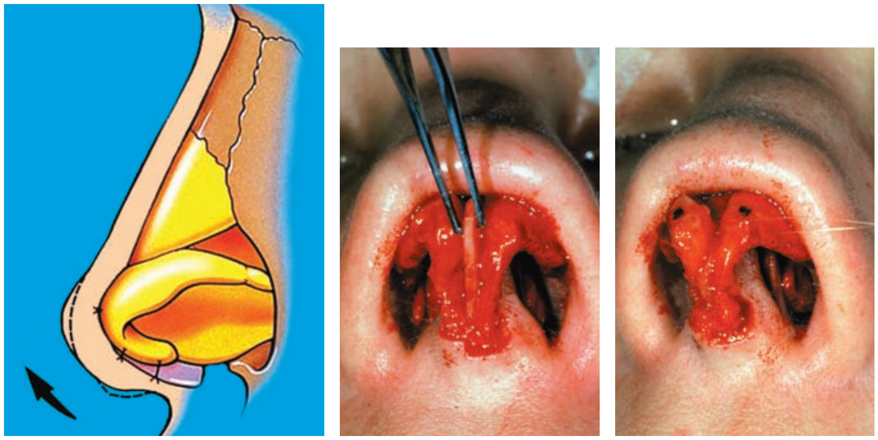
lateral cartilages and produce a relative concavity lateral to the middle crura. If these maneuvers are performed in the presence of weakened lower lateral crura, alar retraction, notching and/or external valve collapse may occur.

Lower Lateral Crural Turnover Flap



As opposed to cephalic trim of the lower lateral crura, the lower lateral crural turnover flap can be used to preserve this cartilage and use it to correct concavities/convexities of the lower lateral crus, strengthen the external valve, and oppose pinching of the tip caused by tip suturing.[45] This exploits intrinsic concavities or convexities of the lateral crus and repositions these forces into opposition resulting in correction of the deformity. This flap is particularly useful when the lower lateral cartilages appear weak and will help to reduce tip fullness while making use of the intrinsic strength of the lower lateral cartilages.

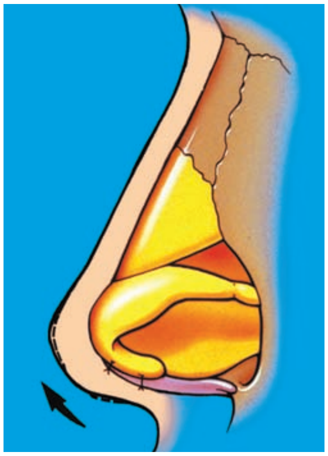
Columellar Strut Graft



The columellar strut graft is used for tip unification, correction of medial crural asymmetry, maintenance of tip projection, and establishment of a foundation for nasal tip refinement.[46,47] Septal cartilage is preferred and the columellar strut graft is usually approximately 25 by 4 mm. Most commonly, the columellar strut graft is invisible between the medial crura but can be made visible when increased columellar show and infratip lobular augmentation are required. The columellar strut graft serves a crucial role in maintaining the additive changes that result from various tip-suturing techniques.

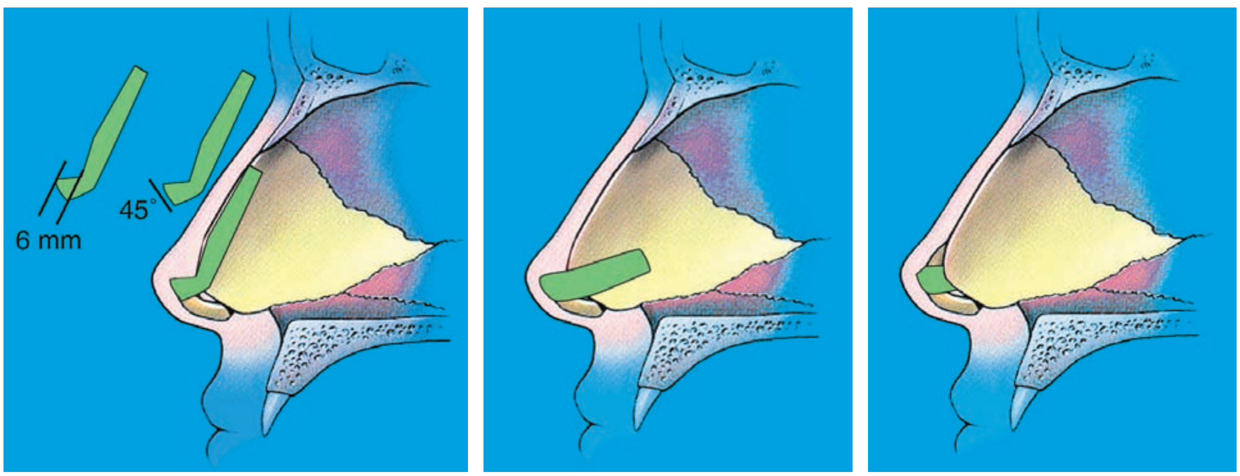
Columellar struts are the mainstay in providing a stable and strong nasal base that will allow more liberal use of other tip-suturing techniques.

There are two variations of columellar strut grafts, floating and fixed. The floating strut graft is most commonly used and is inserted between or caudal to the medial crura. Its posterior portion rests in the soft tissue 2 to 3 mm anterior to the anterior nasal spine to prevent audible or palpable clicking against the maxilla. The medial crura are secured to the strut graft with 5-0 PDS horizontal mattress sutures at the junction of the medial crura with the middle crura (medial crural suture). Two additional sutures (interdomal sutures) are often placed anterior to the first suture to fix the medial portions of the domes to the strut. These interdomal sutures help camouflage the graft making it invisible and nonpalpable. The columellar strut graft is then further refined, trimmed, and shaped, depending on the requirements of the infratip lobule. The floating columellar strut graft can provide 1 to 2 mm of additional tip projection.



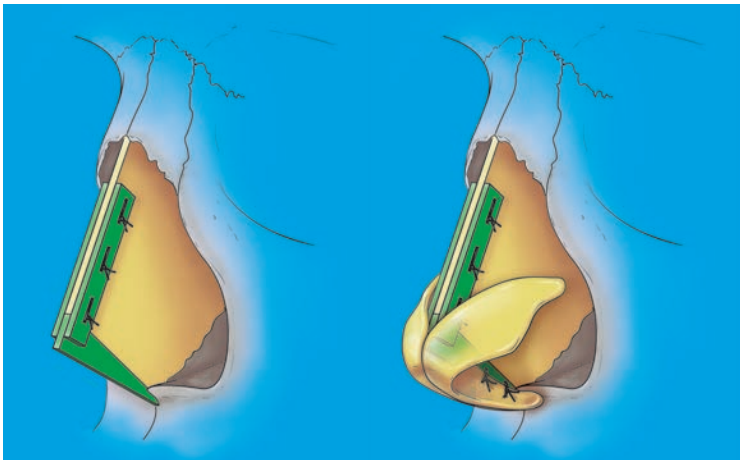
When more than 3 mm of tip projection is needed, a fixed strut graft can be used. Commonly this is harvested from rib cartilage, notched at the portion abutting the nasal spine, and can be fixed in place using 5-0 PDS sutures to the periosteum.

Septal Extension Graft



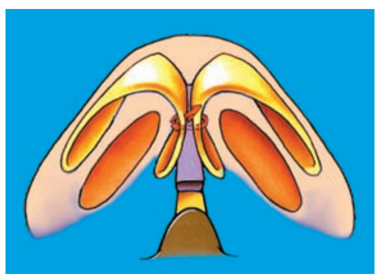
Paired extended spreader grafts   Paired batten grafts   Direct extension graft

Dissatisfaction with the control and maintenance of tip projection in cases of midvault collapse (inverted-V deformity) using columellar strut grafts led to the septal extension graft described by Byrd et al.[12] This graft can be an extended spreader graft, a batten graft, or a direct septal extension graft. The graft extends beyond the anterior septal angle into the interdomal space. The upward angle of the graft is often 45 degrees, and the length of the tip portion averages 6 mm. The graft should be fixed inferior to the divergence of the middle crura and to a second point of fixation interdomally. Using this graft, the differential between the domal height and the nasal dorsum plane (commonly 4 to 6 mm) can be controlled.

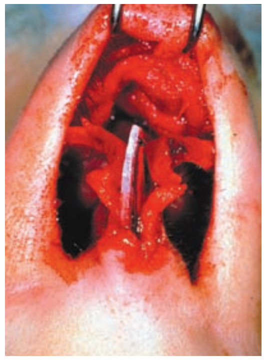


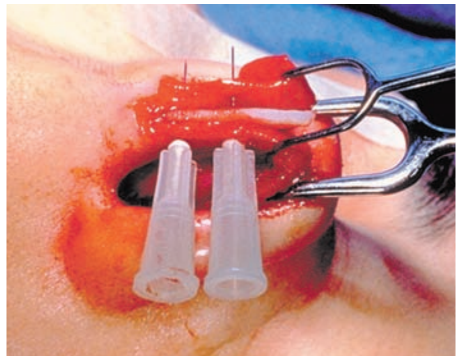
Guyuron and Varghai[48] described the tongue-and-groove technique as an effective method to create and maintain tip projection when nasal lengthening is also required. Bilateral extended spreader grafts that extend beyond the caudal septum are sutured to the septum and a caudal septal extension graft is positioned between the groove created by the extended spreader grafts. Suturing the medial crura to the caudal septal extension graft provides stability to the construct.

Medial Crural Suture



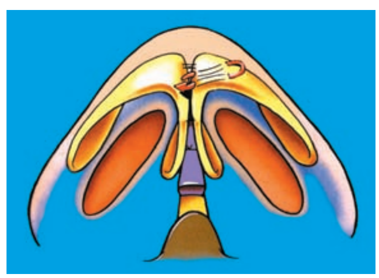
Intercrural or medial crural sutures are the first sutures placed and can be used in isolation to correct medial crural asymmetries, to reduce flaring, and to control the overall width of the columella. The positioning of the medial crural suture is dictated by the underlying deformity and intended goal. If flaring is to be altered, the suture should be placed in the region of the footplates. When the goal is to correct convexities and asymmetries in the columella, then the suture should be placed at the apex of that convexity to flatten it.





Most commonly, medial crural–columellar strut sutures are placed in the middle third of the medial crura to secure it to the columellar strut graft. Temporary straight-needle fixation will help ensure accurate suture placement. Fixation to a columellar strut can increase both tip projection and tip strength simultaneously as the medial crura are elevated toward the anterior septal angle. These maneuvers are often required before other tip sutures are placed because the medial crural–columellar strut complex acts as a point of stability in the nasal tripod, and can limit the dynamic effects suture techniques have on the cartilaginous framework.[3,26] This process allows a more controlled and incremental approach to tip refinement. As with any tip-suturing technique, the degree of tightening is proportional to the intensity of the effect.

Transdomal Suture



Transdomal sutures are placed usually after the nasal base has been stabilized using medial crural suturing with a columellar strut graft. This is a horizontal mattress suture that is placed through the lateral and medial aspects of the domes. The entry and exit sites of the mattress suture are important—because the suture is placed farther away from the dome apex, greater lateral crural concavity and tip projection are produced, depending on the amount of suture tightening. Differential placement of this suture can be used to correct domal asymmetries of position and shape. For instance, caudad or cephalad placement of the suture

will rotate the lateral crura, respectively.[26] The transdomal suture is a powerful suturing technique, and care should be taken to avoid creating unnecessary tension on the lateral crura, excess concavity adjacent to the domes, and more tip projection than required.

Suturing techniques should be employed incrementally, starting with the medial crural–columellar strut suture to secure and stabilize the columellar strut graft.

If a septal extension graft is used, this is secured to the septum first, before suturing techniques are employed. Transdomal sutures are commonly required and are a powerful tool in simultaneously controlling tip projection and definition. Medial crural septal sutures may be placed to affect tip rotation and drooping.

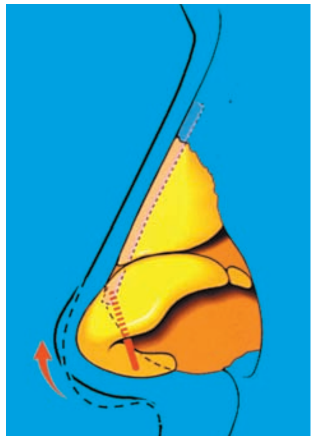
Interdomal Suture

The interdomal suture is a horizontal mattress suture placed between the domal segments of the middle crura of the lower lateral cartilages. This suture is rarely indicated without concomitant transdomal sutures, and when used in isolation can potentially decrease tip projection by flattening the domes. Transdomal sutures can be placed first, because some interdomal narrowing can be achieved. The suture ends of the transdomal suture can be left long and tied to one another to duplicate the effect of an interdomal suture, if indicated.

The interdomal suture technique decreases the angle of domal divergence, narrows the tip-defining points, can further camouflage a columellar strut graft or septal extension graft and enhance the infratip lobule, and increases projection.

When the suture is placed in the caudal portion of the domes, this technique can also rotate the lateral crura caudally.[26] When improperly placed, interdomal sutures can have deleterious effects on tip shape by unifying the tip-defining points, reducing domal definition, and excessively narrowing the nasal tip.

Medial Crural Septal Suture



Medial crural septal sutures can be placed after all other tip-suturing techniques are performed, or concomitant with medial crural suturing when significant tip rotation and repositioning is anticipated preoperatively. Medial crural septal sutures secure the middle crura to the caudal septum and can be used to reduce or increase nasal tip projection, depending on the placement. If the medial crura are anchored to a more anterior position on the caudal septum, the tip will rotate in a cephalad direction and tip projection will increase.

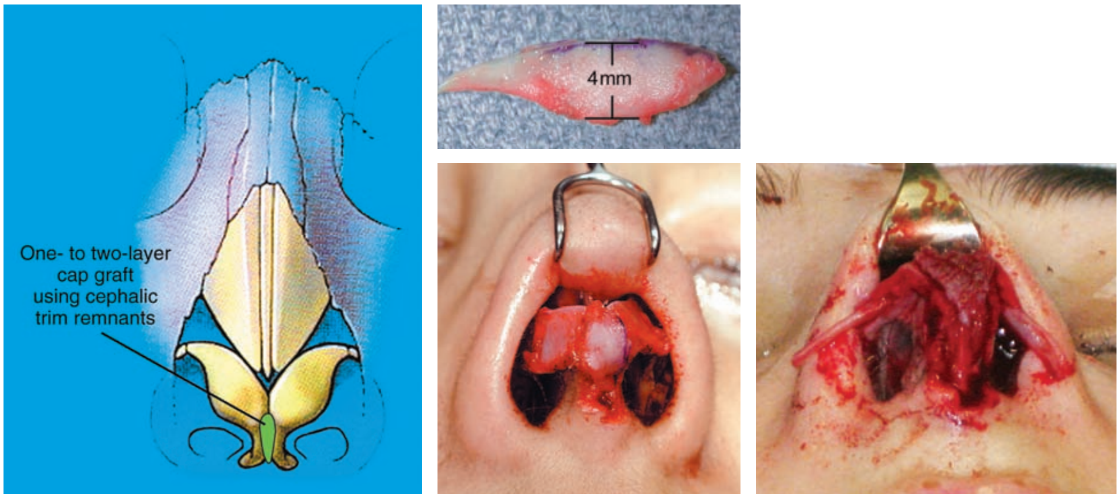
Conversely, if the medial crura are fixed to the more posterior portion of the caudal septum, tip projection will decrease. This can also result in tip derotation and reduction of the columellar-labial angle as well as the nasolabial angle. If undue tension is placed on the medial crura at the anterocaudal septum position, columellar retraction may occur. As with the medial crural suture, preliminary needle fixation will help facilitate proper suture placement.

The medial crural septal suture is often indicated in the aging and drooping tip for its effects on tip rotation and projection.

Similar effects can be achieved by suturing the medial crura to a fixed columellar strut graft or a septal extension graft.[12] This may be indicated when the caudal septum is resected to rotate the tip, and suturing the medial crura to the new septal position will cause a retracted columella.

Invisible Tip Grafts

Invisible tip grafts are preferred over visible tip grafts because visible grafts can reabsorb, develop asymmetry, and/or become sharply angulated over the long term, necessitating revision.



Invisible tip grafts, including the anatomic cap graft and morselized cartilage onlay grafts, are used if a small degree of tip contouring or volume augmentation is desired after tip suturing is completed. Cartilage resulting from the cephalic trim of the lower lateral cartilage can be used to fashion an anatomic cap graft.[49] This cartilage graft is typically thin and pliable so it contours over the tip very well and it does not have any distinct edges, so palpability and/or visibility of the graft is not a problem. If the tip requires minimal augmentation or improvement of mild irregularities, morselized cartilage onlay grafts can be placed. The cartilage is morselized in a cartilage crusher and can range from being slightly bruised (to make it less rigid and more conforming without sharp edges) to crushed into a thin sheet (which can act as scaffolding for tissue ingrowth). Morselized cartilage onlay grafts can be used anywhere for augmentation or correction of mild irregularities.

Depressor Septi Nasi Muscle Surgery

In some patients, the depressor septi nasi muscle may decrease tip projection by pulling the tip caudally and posteriorly. Transnasal release or transoral dissection and transposition of the muscle is indicated when hyperdynamic nasal tip ptosis and underprojection are noted preoperatively. It is important to realize that in-

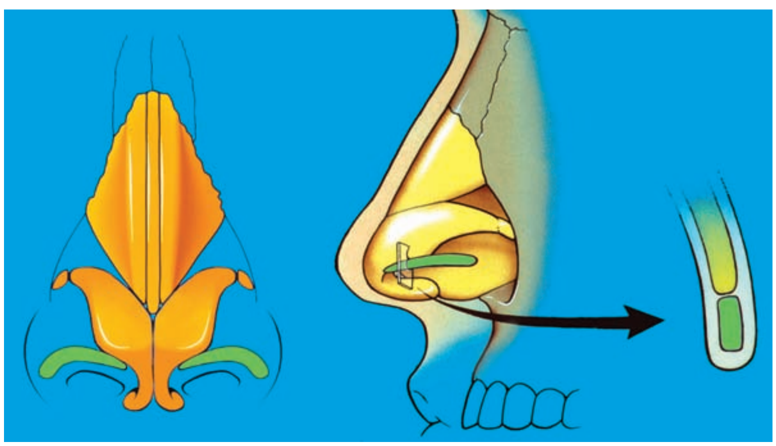
traoperative evaluation of the depressor septi nasi muscle is unreliable, because animated views are required.[41,50]

Intraoperative evaluation of the depressor septi nasi muscle is unreliable, because animated views are required.

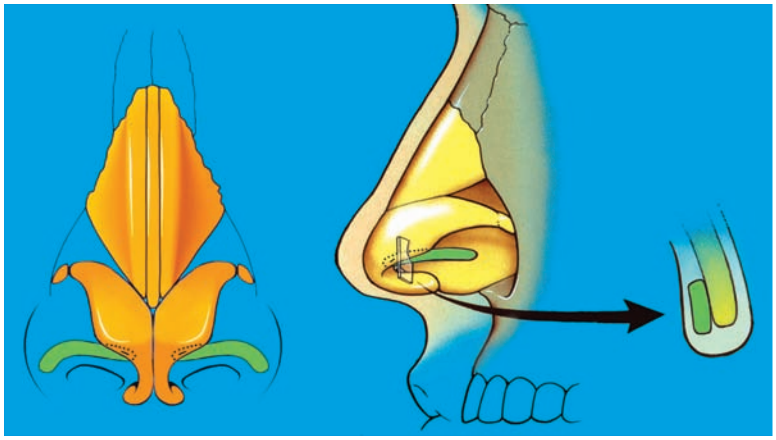
Lateral Crural Malposition

The lower lateral cartilage is the structural cornerstone for the alar rim and overall tip support. However, it is the strength, anatomic positioning, and orientation of the lateral crus that are paramount to the location, contour, and stability of the ala. External valve collapse, notching, and retraction can all become apparent when the lateral crus is unable to provide proper support for nasal soft tissues that become further stressed with inspiratory effort. If excessive lateral crural convexities or concavities are present but tip projection and balance have been achieved, alar contour grafts or lateral crural strut grafts can be used to provide support and to prevent future loss of alar rim integrity.[51,52]

Alar Contour Grafts

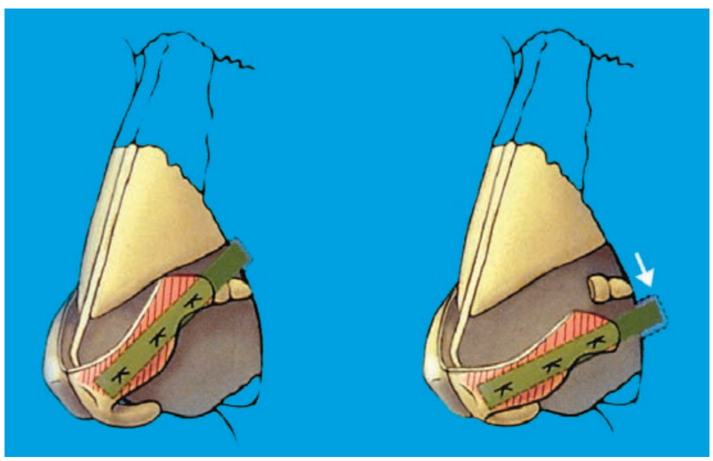


The alar contour graft provides a foundation for reestablishing a normally functioning external nasal valve and an aesthetically pleasing nasal tip and alar contours. The use of alar contour grafts decreases the risk of alar deformities including alar notching or retraction, as well as excessive concavity or convexity of the alar rim.



The extended alar contour graft can influence the rotational orientation of the lateral crus so that the caudal and cephalic borders are rotated into the same horizontal plane further influencing the tip and alar contours. Alar contour grafts are almost always placed at the end of the operation.

Lateral Crural Strut Grafts



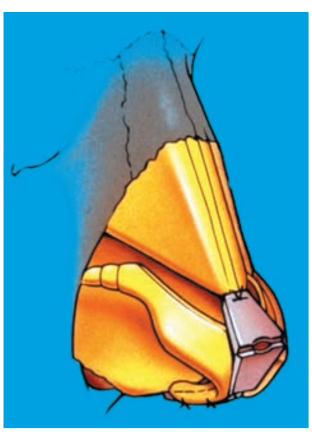
Lateral crural strut grafts are commonly placed before tip modifications, and before a columellar strut graft, to reorient and/or stabilize the alar arch.[52] Added support to the nasal tip and alar arch is provided by lateral crura that lie in the same rotational plane with respect to their caudal and cephalic margins.[40] When the caudal margin of the lateral crura is oriented below the cephalic margin (lower lateral cartilage malposition), a *parenthesis tip* can result, which frequently requires lateral crural repositioning with the use of a lateral crural strut graft (frequently with transection at the accessory chain) in addition to other tip-shaping techniques.[53]

Final Assessment and Refinement

The shape and projection of the nasal tip are critically assessed before and after redraping the skin envelope. The balance between the nasal dorsum and the tip-defining points is scrutinized to control the supratip break and prevent a future pollybeak deformity. The tip-defining points should project approximately 6 to 10 mm over the nasal dorsum in female patients.[54] Asymmetry and/or contour deformities (visible and/or palpable) are corrected using incremental suture and graft adjustments. Large dorsum-tip discrepancies can often result from an inadequate columellar strut graft and/or a poorly positioned medial crural septal suture. Smaller discrepancies can result from poorly executed transdomal sutures and/or interdomal sutures. It is important to alter one suture at a time, so that the result is not influenced by multiple variables.

The skin envelope should be redraped after each suture is placed to determine whether modifications in position or degree of tightness are needed.

Visible Tip Grafts

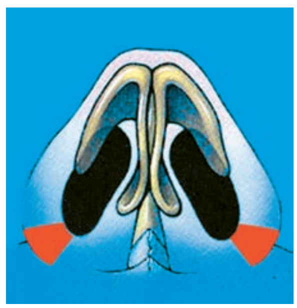


If the final tip projection is inadequate despite the incremental application of the previously described suturing and grafting techniques, meticulously placed visible grafts are used, such as infratip, onlay, and combined tip grafts. These can be applied using septal or conchal cartilage.

The dimensions of these grafts are critical, because supratip, infratip, and domal landmarks can become blunted if these grafts are not accurately curved at anatomic breakpoints. In addition, grafts that may initially appear hidden may become visible with time as the skin envelope becomes less edematous.

If the desired tip projection and refinement are not achieved using available invisible/nonpalpable tip suturing and cartilage grafting techniques, then visible/palpable cartilage grafts may be used. These include an assortment of infratip, onlay, and combined tip grafts.

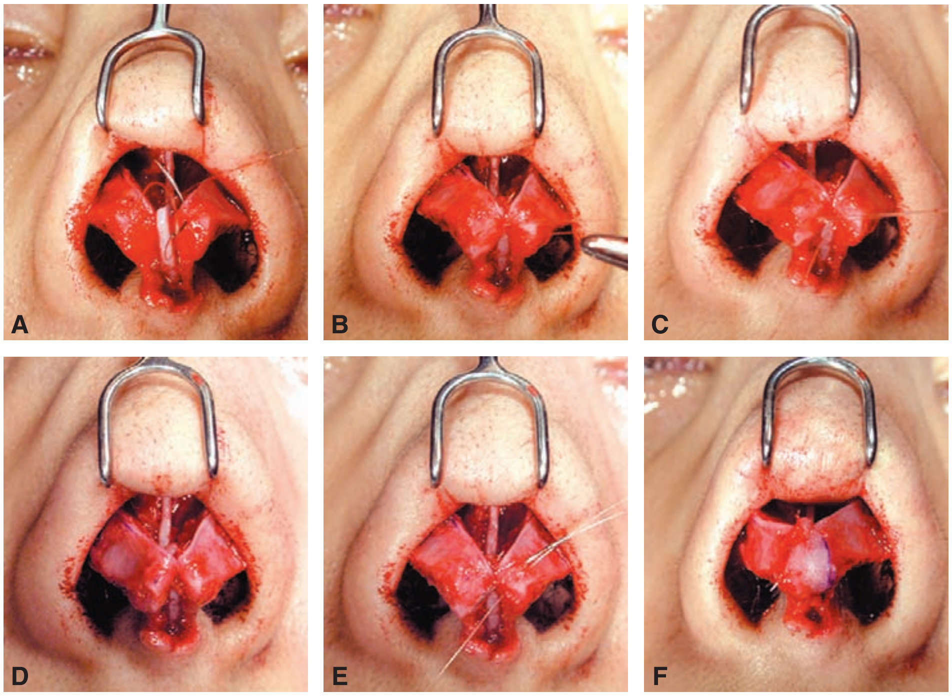
Nostril-Lobule Imbalance



Nostril-tip balance should also be reassessed and corrected, when indicated, with appropriate nostril-shaping techniques and other final tip adjustments. When preoperative nostril-tip disproportion is recognized, the surgeon should observe the dynamic changes that have been made to this imbalance intraoperatively. For a patient with large nostril–small tip disproportion, excising a complete wedge of alar tissue reduces both alar flaring and the nostril circumference.[42] When the patient has a short nostril, there is often lobular excess. In this case, a soft triangle excision is required, with or without transdomal sutures to elongate the nostril apices.[39] Care must be taken to avoid exaggeration of a short nostril deformity, which can result from maneuvers that increase tip projection and/or augment the infratip lobule without concomitant techniques that elongate the nostril.[39]

Nostril-lobule imbalances must be assessed preoperatively and reassessed intraoperatively, because a preexisting disproportion may be exaggerated by augmenting the tip and failing to address the nostril.

OPERATIVE TECHNIQUE FOR AN ALGORITHMIC APPROACH



1. The cartilaginous framework is exposed using the open rhinoplasty approach with a stair-step transcolumellar incision and bilateral infracartilaginous incisions. The lower lateral cartilages are separated from the upper lateral cartilages at the scroll area.
2. After addressing any required dorsal reduction, septal cartilage is harvested as necessary for later use as grafts, taking care to maintain adequate septal/dorsal support.
3. A conservative cephalic trim is performed, as necessary.
4. Nonpalpable/invisible methods are initially used to address the nasal tip. A columellar strut graft is first placed to maintain or enhance tip projection. If the preoperative analysis calls for 1 to 2 mm of additional projection, we generally prefer to use a floating columellar strut graft fashioned from the harvested septum. Care is taken to dissect the soft tissue pocket for the graft to a point 2 to 3 mm anterior to the anterior nasal spine (A). The fixed columellar strut graft fashioned from rib cartilage is used only when a significant amount of increased projection is required. This graft is placed in a soft tissue pocket dissected down to the anterior nasal spine and straddles the spine.

5. The majority of tip refinement and incremental enhanced projection is achieved with tip-suturing techniques. Medial crural sutures are first placed to stabilize the medial crura to each other or to the columellar strut graft. This maneuver allows the surgeon to precisely estimate the desired tip projection and to unify the tip.
6. Interdomal sutures are placed between the domal segments of the middle crura of the lower lateral cartilages (B and C), primarily to increase infratip-columellar projection and/or refinement. In cases of domal asymmetry, individual unilateral or bilateral transdomal sutures are placed between the domal and lobular segments of the middle crura (D and E). As this suture is tightened, the domes are brought into symmetry. Care must be taken not to overtighten this suture to avoid alar pinching or collapse.
7. During the placement of individual tip sutures the nasal skin should be redraped frequently to assess the adequacy of tip projection and refinement after each alteration. If the effect of a suture is undesirable, the suture is simply removed and/or replaced. It is important to remember that with the open approach, 1 to 2 mm of tip projection will be lost before the final postoperative form has been achieved.
8. In approximately 60% to 70% of primary patients these techniques will result in the desired tip alteration. If tip projection/refinement is still inadequate, then tip grafting techniques are used. We frequently use remnants from cephalic trim, which may have been performed as a combination tip graft, especially in thin-skinned patients. It may be secured to the columellar strut grafts or medial crura and anterior septal angle with 5-0 PDS (F). These grafts will soften the appearance of the domes and will be invisible, even through a thin skin envelope. In the very thick-skinned individual who requires increased projection, onlay grafts are used, beveling the edges as necessary. Infratip grafts may be necessary primarily to enhance infratip lobular refinement, or combined grafts may be used to enhance both projection and infratip lobular definition.
9. Once the final desired tip refinement and projection have been achieved, the remainder of the operative procedure is performed, including osteotomies (as necessary), meticulous incision closure, and standard splinting.

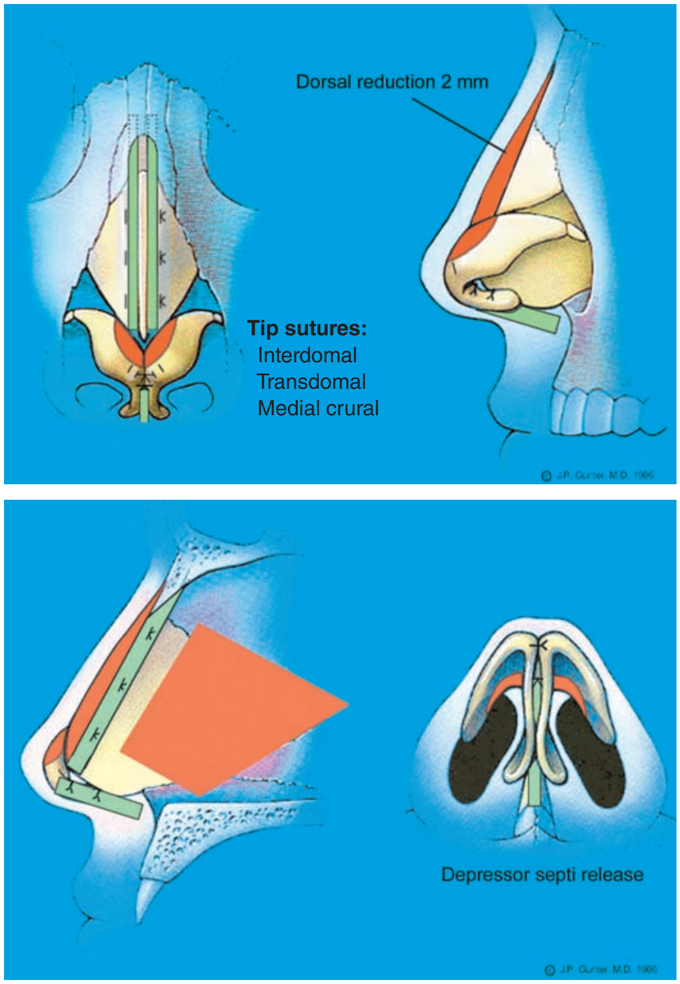
As much as 1 to 2 mm of tip projection will be lost before the final postoperative tip projection has been achieved using the open approach.

CASE ANALYSES

This 20-year-old woman presented for treatment of nasal obstruction, greater on the left than on the right; she also had a dorsal hump and a wide, amorphous nasal tip.

Nasal analysis revealed the following:

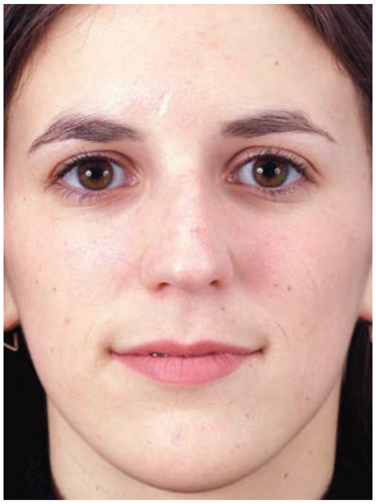
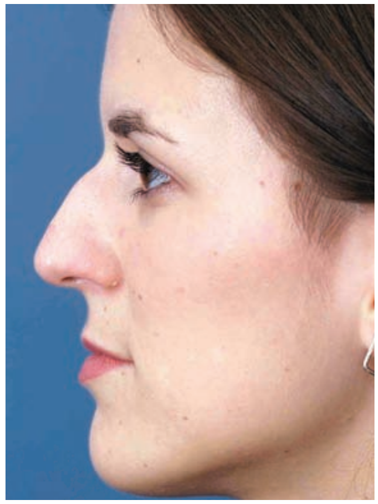
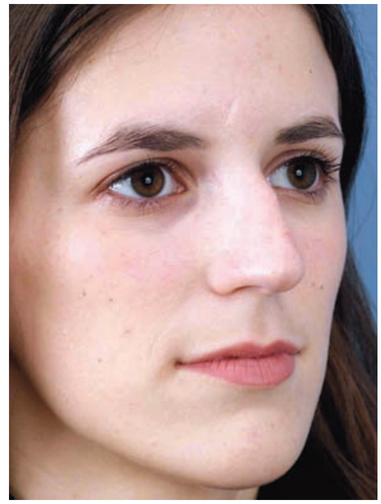
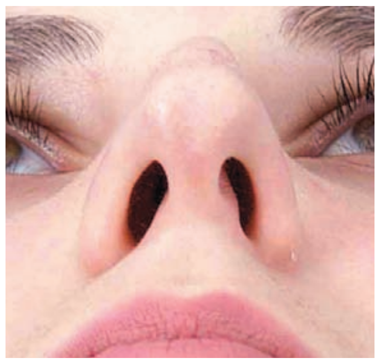
- A narrow midvault and slight dorsal hump (2 mm)
- An underprojected and boxy nasal tip with moderately asymmetrical lower lateral cartilages
- Large nostril to small tip–lobule imbalance
- A hyperactive depressor septi nasi muscle
- Anterior septal deviation
- Bilateral inferior turbinate hypertrophy



Surgical Plan

1. Use an open approach with transcolumellar incision and infracartilaginous extensions.
2. Perform septal reconstruction and harvest cartilage graft material.
3. Reduce the dorsal hump (2 mm) in component fashion.
4. Perform a cephalic trim, leaving symmetrical alar cartilages and a 6 mm alar rim strip.
5. Place a floating columellar strut graft.
6. Use medial crural, interdomal, and transdomal sutures.
7. Place bilateral invisible spreader grafts to widen the midvault and to stent the internal nasal valve.
8. Perform bilateral anterior-inferior turbinate resection.
9. Perform depressor septi muscle release and transposition.

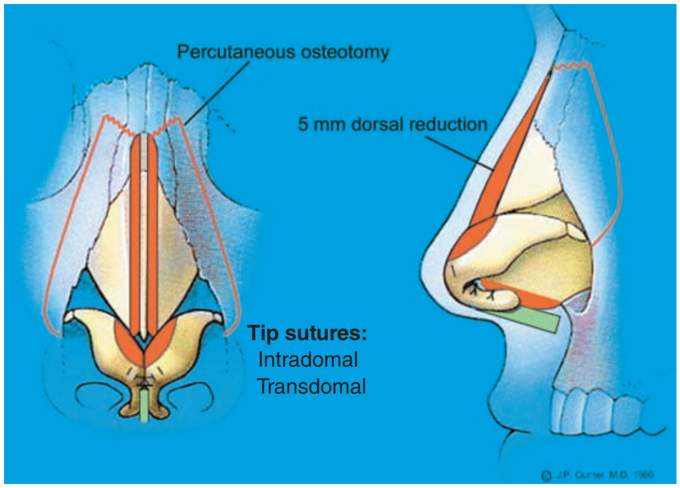
The patient is shown 12 months postoperatively; she is pleased with the aesthetic result as well as the improvement of the nasal airway obstruction. The tip has appropriate projection, and the boxy tip has been corrected with creation of aesthetically pleasing tip-defining points and contour, using invisible/nonpalpable tip-suturing and grafting techniques.

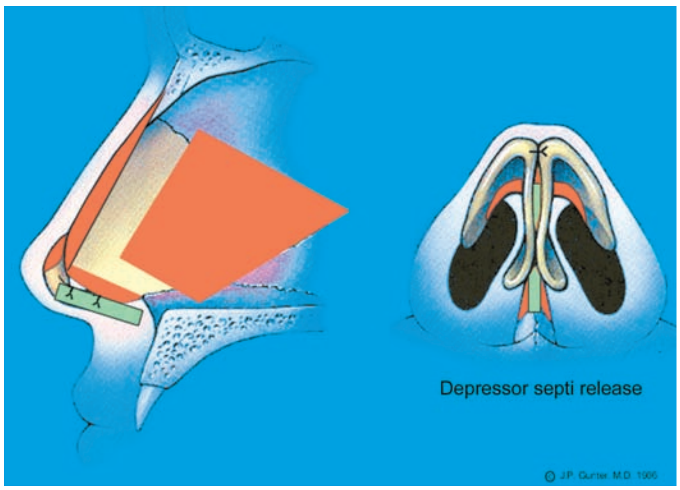





This 21-year-old woman had sustained nasal trauma 2 years earlier. Her reasons for desiring surgery were nasal airway obstruction, greater on the left side than on the right, a significant dorsal hump with asymmetrical nostrils, and a wide, poorly defined nasal tip.

Nasal analysis revealed the following:

- A significant osteocartilaginous dorsal hump (5 mm at its greatest point)
- A C-shaped nasal septal deformity
- A high dorsal septal deviation
- A bifid nasal tip
- Asymmetrical nostrils with left narrowing and a short nostril-to-large tip (lobule) disharmony
- A hyperactive depressor septi nasi muscle
- Compensatory right inferior turbinate hypertrophy





Surgical Plan

1. Use an open approach with transcolumellar incision and infracartilaginous extensions.
2. Perform septal reconstruction and harvest cartilage graft material.
3. Perform dorsal hump reduction (5 mm) in component fashion.
4. Reduce the caudal septum (3 mm).
5. Perform a right inferior turbinate resection.
6. Perform bilateral percutaneous perforated lateral osteotomies (low-to-low).
7. Perform a cephalic trim, leaving a 6 mm alar rim strip.
8. Place a floating columellar strut graft with medial crural suturing.
9. Refine the tip with interdomal and transdomal sutures.
10. Perform depressor septi nasi muscle dissection and transposition.

Twelve months postoperatively, the patient has a smooth, straight nasal dorsum with symmetrically shaped nostrils, consistent tip projection, and improved tip definition. The patient's nasal breathing has been significantly improved.

KEY POINTS

- The appearance of ideal tip projection is dependent on the relationship of the nose-lip-chin complex, because an underprojected chin will make the nasal tip seem overprojected, and vice versa.
- In a patient with thick, sebaceous skin, alterations to the cartilaginous framework may need to be more aggressive to produce adequate tip definition and projection.
- Adequate tip projection is defined as 50% to 60% of the tip lying anterior to the most projecting point of the upper lip.
- Great care should be taken to preserve or restore the anatomic integrity of the tip-supporting structures.
- Columellar struts are the mainstay in providing a stable and strong nasal base that will allow more liberal use of other tip-suturing techniques.
- Suturing techniques should be employed incrementally, starting with the medial crural–columellar strut suture to secure and stabilize the columellar strut graft.
- Intraoperative evaluation of the depressor septi nasi muscle is unreliable, because animated views are required.
- The skin envelope should be redraped after each suture is placed to determine whether modifications in position or degree of tightness are needed.
- If the desired tip projection and refinement are not achieved using available invisible/nonpalpable tip-suturing and cartilage grafting techniques, then visible/palpable cartilage grafts may be used. These include an assortment of infratip, onlay, and combined tip grafts.
- Nostril-lobule imbalances must be assessed preoperatively and reassessed intraoperatively, because a preexisting disproportion may be exaggerated by augmenting the tip and failing to address the nostril.
- As much as 1 to 2 mm of tip projection will be lost before the final postoperative tip projection has been achieved using the open approach.

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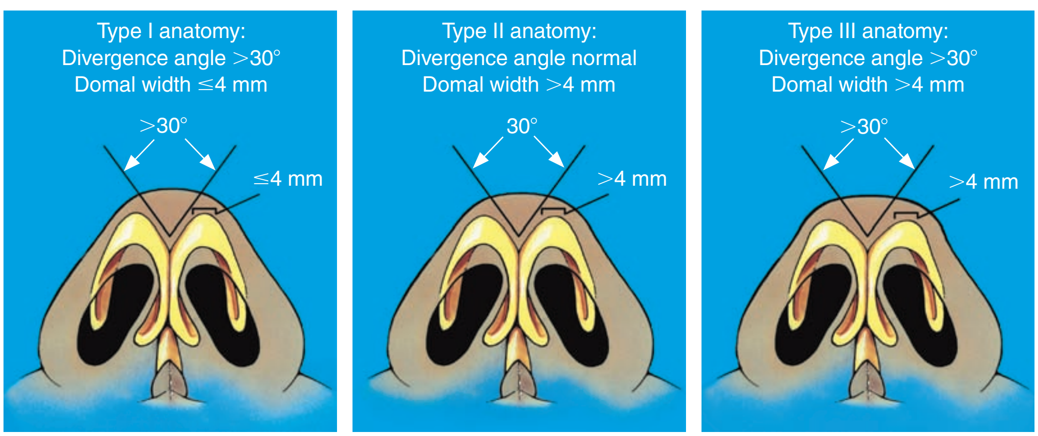
22

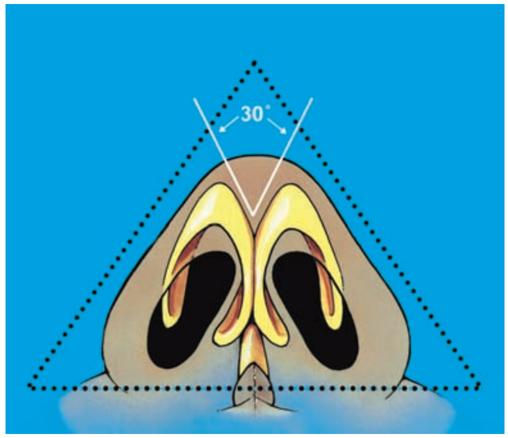
Correction of the Boxy Nasal Tip Using the Open Approach

Rod J. Rohrich ▪ William P. Adams Jr. ▪ Jamil Ahmad

The boxy nasal tip is defined as a broad, rectangular tip, as seen on the basal view. This is described anatomically using the open approach as one of three types.[1-4]



Type I is characterized by an increased intercrural angle of divergence (more than 30 degrees) and normal dome arc (4 mm or less) that are manifest as the tip-defining points. Type II shows an increased angulation of the domes of the lower lateral cartilage segment that creates a widened dome arc (more than 4 mm)[5,6] and normal angle of divergence (30 degrees or less). Type III represents a combination of an increased angle of divergence (more than 30 degrees) and widened crural dome arc (more than 4 mm).



Correction of the boxy tip includes repositioning the tip-defining points, angulating the domes, and shaping the lateral crura so the basal view appears triangular with a slightly rounded apex and straight or slightly concave lateral walls. The width of the tip is determined by the distance between the tip-defining points, the angulation of the domes, and the thickness of the skin. The position and shape of the lateral walls depend on the angulation of the domes and the shape (flat, convex, concave) and orientation (horizontal versus cephalad) of the lateral crura.

The operative goal is to reposition the tip-defining points, angulate the domes, and shape the lateral crura.

Although a variety of techniques are available, consistent surgical correction of the boxy nasal tip has proved particularly diffult.[1-4,6-9] In this chapter we will discuss the techniques for correction of the boxy tip and present our algorithmic approach for the management of the boxy tip using the open approach.

EVOLUTION OF TECHNIQUES

With careful preoperative and intraoperative analysis, a variety of potentially reversible reshaping suture techniques, and an individualized algorithmic approach, the boxy tip can be accurately and consistently corrected.

Rhinoplasty techniques for correcting the boxy tip have evolved from aggressive intervention (transection and resection techniques) to a gradual transition, and then to more moderate, measured, and potentially reversible reshaping techniques (cartilage conservation and suturing).

The transection and resection techniques used initially have been replaced with cartilage conservation and suturing.

Previously described methods include the following: (1) resection techniques of the lower lateral cartilages, (2) cartilage scoring, (3) cephalic trim of the lower lateral cartilages, and (4) cartilage suturing methods. These techniques have been used alone or in combination, depending on the individual patient's nasal skin thickness and dome cartilage contour.

Alar cartilage suturing, scoring, transection, and cephalic trim, individually or in various combinations, are satisfactory for correcting the vast majority of boxy nasal tips.

Alar Cartilage Transection/Resection

Joseph[10] described transection of the lower lateral cartilages in the dome areas with excision of full thickness alar wedges for the boxy tip. Subsequent authors reported using cartilage transection to reshape the nasal tip.[11-15] Goldman[12] divided the alar cartilages lateral to the domes and sutured them to the medial crura. This effectively produces a more triangular tip. Its adverse long-term sequelae, however, include visible asymmetries, alar rim collapse with pinching of the nasal tip, and creation of a single tip-defining point.[16] It also rotates the tip-defining points more cephalad, thereby increasing infratip lobular height.

McKinney and Stalnecker[14] described a technique of partially resecting the alar dome and reapproximating the medial and lateral crura. This reduced the visibility of the sharp cartilage edges, which are problematic in thin-skinned individuals. Nasal tip camouflage can also be obtained by placing crushed cartilage grafts over the transected cartilages.[15]

Cartilage transection and resection can be used to significantly narrow the boxy tip; however, the consistency and reliability of these methods is questionable.[16-21] The long-term complications of notched alar rims, pinched tips, alar collapse, asymmetry, and loss of tip support limit their usefulness.

Long-term complications of notched alar rims, pinched tips, alar collapse, asymmetry, and reduced intrinsic tip support limit the usefulness of alar cartilage transection and resection.

Cartilage Scoring

Lower lateral crural cartilage scoring permits tip reshaping without the possible step-off with transection techniques. Sheen and Sheen[5] initially described narrowing the boxy tip by interdigitating partial-thickness cuts in the dome and medial crura. Later, they described dome resection and cephalic trim with or without tip grafts, depending on the nasal tip projection required. Peck[6] excised the lateral aspect of the lateral crus, scored the dome, and repositioned the lateral crus after wide mobilization. Cartilage scoring may also be used in conjunction with suture plication of the domes.[7]

Cartilage scoring is less likely to cause the sequelae seen with transection or resection techniques. Maintaining alar rim strip continuity ensures greater tip support and less visibility of cut edges. However, scoring does weaken the alar rim strip and may decrease tip projection.

Lower lateral crural cartilage scoring weakens the alar rim strip and may decrease tip projection.

Incisions are limited to the anterior lateral crus since more posterior scoring may cause significant alar weakness and subsequent collapse. Depending on the quality and strength of the lower lateral cartilages, at least 6 mm of intact alar rim strip should be preserved when scoring the domes. The disruption of cartilage integrity makes results unpredictable in rhinoplasty.[20] Scoring techniques should be used with caution.

Lower lateral crural cartilage scoring is generally limited to thick-skinned patients with resilient lower lateral cartilages.

Cephalic Trim

Resection of the cephalic margin of the dome of the lower lateral cartilages has been described extensively for the treatment of the boxy tip.[20,22-25] This is particularly useful for the boxy nasal tip if the resection is carried onto the anterior portion of the middle crura. Cephalic trim not only reduces tip fullness but also decreases the distance between the tip-defining points. The latter effect is the result of the natural curvature of the alar cartilages; the cephalic margins of the middle crura are generally in direct contact, whereas the caudal margins are separated. A cephalic trim that incorporates the middle crura enables the caudal margins

to be mobilized toward each other, narrowing the nasal tip.[18] Cephalic trim is particularly useful in the thick-skinned patient to reduce fullness of the nasal tip.

Cephalic trim not only reduces tip fullness but also decreases the distance between the tip-defining points.

It is essential for the lower lateral cartilages to be strong and resilient, otherwise cephalic trim may lead to loss of support to the nasal tip or alae. Despite maintaining at least 6 mm of alar rim strip, weak cartilages may manifest as a pinched nasal tip, alar collapse, or alar retraction. If the lower lateral cartilages are large but appear weak and/or convoluted, performing lower lateral crural turnover flaps will result in reducing tip fullness while preserving the intrinsic support of the lower lateral cartilages.

It is essential for the lower lateral cartilages to be strong and resilient, otherwise cephalic trim may lead to loss of support to the nasal tip or alae. In this case, performing lower lateral crural turnover flaps will result in reducing tip fullness while preserving the intrinsic support of the lower lateral cartilages.

Caution must be used to avoid overresection of the cephalic aspect of the lower lateral cartilages to ensure preservation of the tip-defining points; otherwise a pinched, underprojecting nasal tip may result.

Cephalic trim is performed through an intracartilaginous, cartilage delivery, or open rhinoplasty approach. The resection should include the cephalic portion of the middle wall of the domes, preserving at least 6 mm of intact rim strip. The width of the rim strip that is preserved will depend on the quality and strength of the lower lateral cartilages. In patients who have weak lower lateral cartilages and/or thin skin, conservation of an alar rim strip of 6 or 7 mm will help prevent the pinched tip or alar collapse.

A cephalic trim of the middle and lateral crura has few disadvantages but it is effective in correcting only the mild boxy tip deformity.[7] Frequently it is used in conjunction with other nasal tip reshaping techniques, specifically suturing techniques.

Cephalic trim has several additional effects. Excision of the cephalic margin removes the attachments between the lower and upper lateral cartilages at the scroll area. As a result, cephalic trim can affect both tip projection and rotation.

Excision of the cephalic margin removes the attachments between the lower and upper lateral cartilages at the scroll area and can affect both tip projection and rotation.

Lower Lateral Crural Turnover Flap

As opposed to resection of the cephalic aspect of the middle and lateral crura, the lower lateral crural turnover flap can be used to preserve this cartilage and use it to correct concavities/convexities of the lower lateral crus, strengthen the external valve, and oppose pinching of the tip secondary to tip suturing.[26] The lower lateral crural turnover flap can be performed when the lateral crus has excessive height to allow creation of a cephalic flap that can be turned over to strengthen the remaining alar rim strip. This exploits intrinsic concavities/convexities of the lateral crus and repositions these forces into opposition resulting in correction of the deformity. This flap is particularly useful when the lower lateral cartilages appear weak and will help to reduce tip fullness while making use of the intrinsic strength of the lower lateral cartilages.

Cartilage Suturing

Suturing techniques for correction of the boxy nasal tip have undergone significant changes over the past decade as open rhinoplasty techniques have gained increasing popularity and acceptance. Kridel et al[17] described the lateral crural steal technique, which advances the lateral crura to augment the medial crura. Although this method is based on the same principles as Goldman's technique, the lateral crural steal maintains the integrity of the alar cartilages, thereby avoiding some of the potential complications. This technique is most applicable in the patient with the triad of a boxy, poorly projecting, and underrotated nasal tip, most commonly seen in the ethnic nose.

Suturing techniques leave the alar rim strip intact. In addition, they are incremental, precise, and reversible. We prefer the open rhinoplasty approach and use long acting, absorbable 5-0 PDS sutures when refining the nasal tip.

A more versatile suturing technique is advocated by McCollough and English.[7] After performing a cephalic trim of the alar cartilages, they create a more acute dome angle by placing horizontal mattress sutures from the medial to lateral crura and tightening them until the desired dome shape is obtained. If further

narrowing is desired, the domes are united by suture fixation. They also recommend scoring, transection, or resection of the domes in selected patients.

Suture techniques, unlike cartilage scoring or resection, have the distinct advantage of being nondestructive, incremental, and reversible.

Tebbetts,[20,27,28] a proponent of suturing techniques, performed virtually all tip modifications with sutures alone using the open approach. In contrast with McCullough and English, he first unified the tip complex at the medial crura and then increased dome angularity with sutures. Tebbetts[27,28] also described the lateral crural spanning suture to correct lateral alar convexities.

Suture techniques, unlike cartilage scoring or resection, have the distinct advantage of being nondestructive, incremental, and reversible.[18,19,27,28] We have found these properties particularly useful in the correction of the boxy nasal tip. One problem that we have experienced with dome suturing is occasional medial displacement of the lateral crura. This results from unbalanced suture forces and may cause pinching of the nasal tip and narrowing of the airway in the patient with weak lateral crura. Meticulous placement of these sutures will help to minimize this problem. Additionally, we frequently place alar contour grafts to strengthen the alar rims and prevent alar deformities including alar collapse, notching, and retraction.[29] Occasionally it may be necessary to place an alar spreader graft[30] fashioned from septal cartilage or a lateral crural strut graft[31] to correct this problem by strengthening the lateral crura and preventing alar concavities. Tebbetts[27,28] used a lateral crural spanning graft to correct the same deformity.

We frequently place alar contour grafts to strengthen the alar rims and prevent alar deformities including alar collapse, notching, and retraction.

Manipulation of Skin

Whereas each of the described techniques modifies the lower lateral cartilages, recontouring of the nasal skin and soft tissues has been reported by other authors. Matory[32] and Kridel and Szachowicz[33] routinely defatted the nasal lobule in black and Asian patients. However, our anatomic studies demonstrate that extensive nasal tip defatting may injure the subdermal plexus, jeopardizing the blood supply to the nasal tip.[34] Therefore we generally avoid defatting of the na-

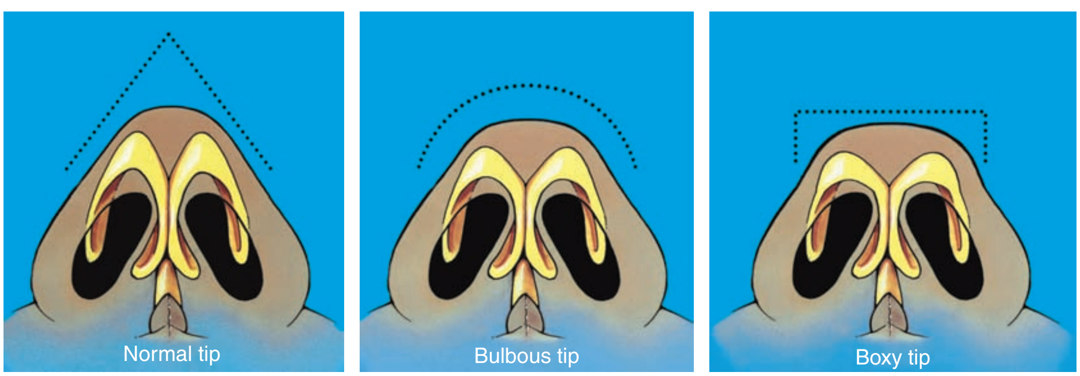
sal tip subdermal fat to refine the nasal tip contour, except for removal of loose fat in the supratip area.[34,35]

Although techniques to correct the boxy tip by recontouring of the nasal skin and soft tissues have been described, extensive defatting of the nasal skin may injure the subdermal plexus and jeopardize blood supply to the nasal tip. For this reason, these techniques should be avoided.

Although Peck[36] usually scored the boxy nasal tip, he advocated narrowing of the nose by partial-thickness skin excision in occasional severe cases. We have no experience with this technique. However, we believe that tip refinement is best achieved through contouring of the underlying nasal framework, leaving the overlying skin and soft tissues intact.[19,37-39]

PREOPERATIVE ASSESSMENT

An accurate assessment of the patient's nasal tip deformity is critical for a successful result. Simply classifying the tip as "too big" or "too wide" is insufficient. Instead, the tip projection as well as the position and distance between the tip-defining points, intercrural angle of divergence, length of the middle crura, and arc of the dome segments are defined. The thickness of the nasal skin and the strength of the alar cartilages are assessed by visualization and palpation.



One must distinguish the normal tip configuration, which is triangular and well defined, from the bulbous tip, which is rounded and ill defined, and the boxy tip, which is square and wide. Each of these factors is important in the preoperative assessment to determine the specific techniques that will best reshape and refine the boxy nasal tip. The intraoperative analysis using the open approach confirms and clarifies the specific anatomic type—specifically, whether the boxy tip is the result of an increased angle of divergence (more than 30 degrees), a widened

dome arc (more than 4 mm), or a combination of the two. Interestingly, the clinical appearance of the bulbous or boxy tip depends partly on skin thickness, with the boxy "phenotype" more common in thinner-skinned patients. Anatomically, the normal nasal tip has an angle of divergence of 30 degrees, a dome arc width of 4 mm or less, and a distance between the tip-defining points of 5 to 6 mm. The operative goal is to recontour a well-defined nasal tip with a triangular appearance on the basal view.

The intraoperative analysis confirms and clarifies the specific anatomic type, specifically whether the boxy tip is the result of an increased angle of divergence, a widened dome arc, or a combination of the two.

MANAGEMENT ALGORITHM

Our algorithm for the correction of the boxy nasal tip is outlined below.[1]

Preoperative Assessment

Open approach

Intraoperative diagnosis

Type I
Increased angle of divergence (>30°)

Domal and middle crural cephalic trim or lower lateral crural turnover flap

Thin skin
Interdomal sutures

Thick skin
Interdomal sutures ± transdomal sutures

Type II
Wide dome arc (>4 mm)
Normal angle of divergence (≤30°)

Domal cephalic trim alone or lower lateral crural turnover flap

Thin skin
Transdomal sutures ± interdomal sutures

Thick skin
Transdomal sutures and interdomal sutures

Type III
Increased angle of divergence (>30°)

Domal and middle crural cephalic trim or lower lateral crural turnover flap

Thin skin
Interdomal sutures and transdomal sutures

Thick skin
Interdomal sutures and transdomal sutures ± domal reconstruction*

Excessive lateral crural convexity or concavity

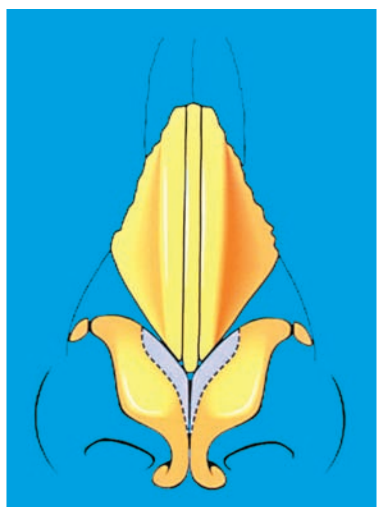
Lateral crural strut grafts
or alar contour grafts
or alar spreader grafts

*Include domal resection and suture reshaping in an excessively wide domal arch (>6 mm) and resilient lateral crura.

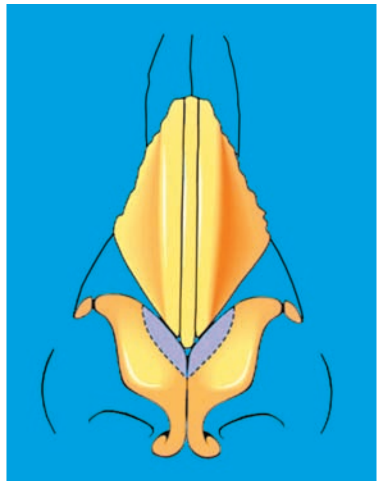
Because no two noses are exactly alike, the rhinoplasty surgeon should not rely on a single technique to correct all boxy tip deformities. This algorithm facilitates the selection of the most appropriate surgical techniques for each patient based on a critical preoperative clinical analysis and intraoperative anatomic assessment.

Through the open approach we use cartilage-sparing and suture techniques that are predictable and potentially reversible. The preoperative assessment of skin thickness, combined with an intraoperative assessment of the dome arc width and angle of divergence, determines the boxy tip type and the techniques most appropriate for correction of the boxy tip deformity.

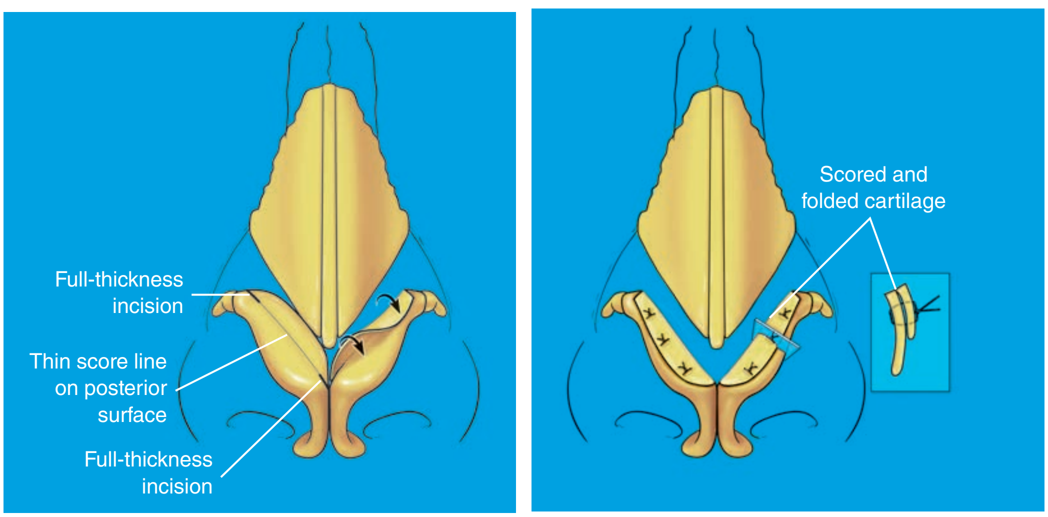
The preoperative and intraoperative assessment includes skin thickness, the dome arc width, and the angle of divergence.



If the predominant cause of the boxy tip is an increased angle of divergence (greater than 30 degrees), as seen in types I and III, a lateral and middle crural cephalic trim maintaining at least 6 mm of intact rim strip is performed.



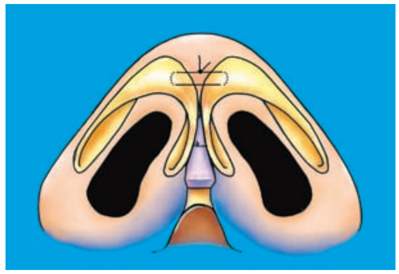
On the other hand, if the predominant factor is a wide dome arc only (more than 4 mm), as seen in type II, a cephalic trim of the lateral crura is performed that leaves the cephalic portion of the middle crura intact.



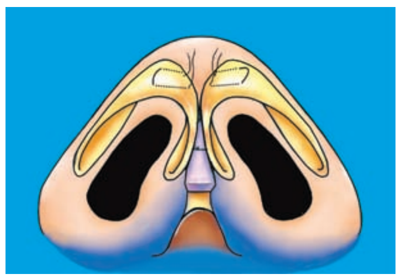
In cases in which the height of the lateral crura is adequate to perform a lower lateral crural turnover flap (greater than 3 mm excess of what is required to preserve the structural integrity of the alar rim strip), this flap is performed to strengthen the alar rim strip.

Despite the dramatic effects of scoring and transection, these techniques irreversibly disrupt the structural integrity of the alar rim strip and can reduce tip support and projection.

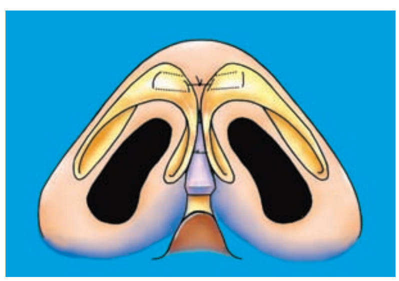
The next intraoperative step is based on the skin thickness to minimize or prevent long-term tip problems.



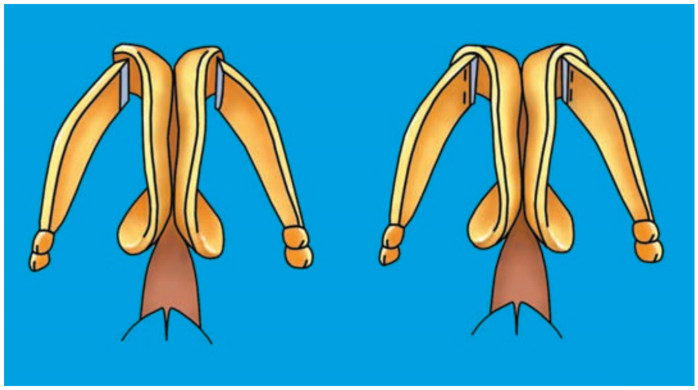
In type I and III boxy tips, 5-0 PDS horizontal mattress interdomal sutures are preferred to correct the angle of divergence.



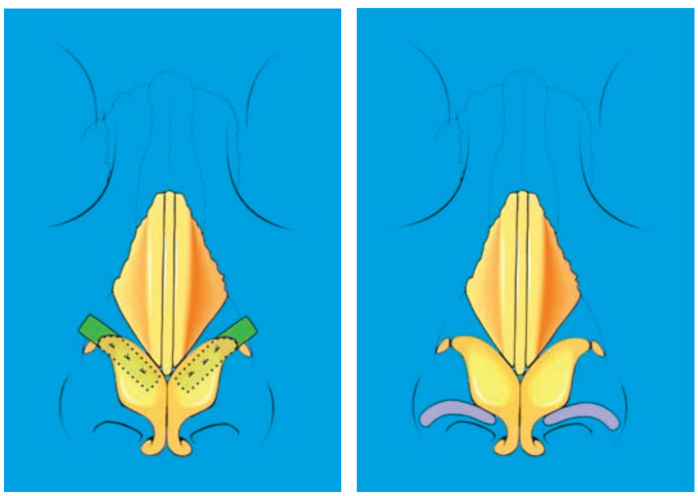
In type II boxy tips, transdomal sutures are used to reduce the dome arc to 4 mm or less.



If further narrowing is required, the transdomal sutures are tied together. The end point is reached when the distance between the tip-defining points is 5 to 6 mm. Interdomal sutures effectively narrow the distance between the tip-defining points, but they have little effect on the width or arch of the dome itself. Therefore we use transdomal suturing to normalize the dome arc and improve dome angularity.



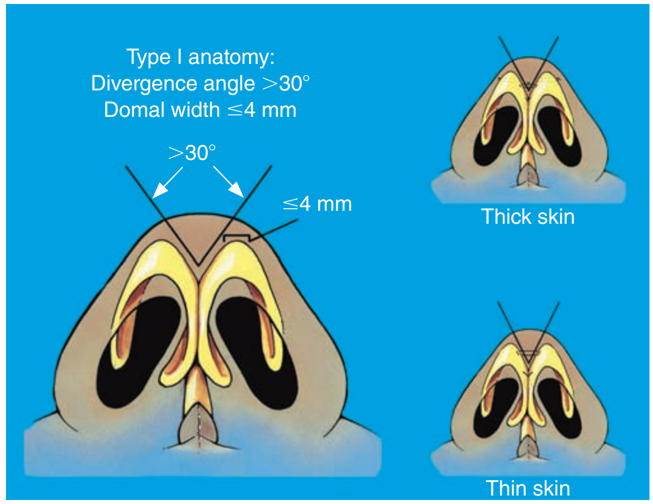
We prefer suture reshaping techniques in most patients. However, in the infrequently encountered type III thick-skinned patient with an excessively wide dome arc (more than 6 mm) and strong lateral crura that are unresponsive to transdomal sutures (that is, causes alar convexity/concavity or excess tip projection), we use precise dome cartilage reconstruction (resection and resuturing) techniques.



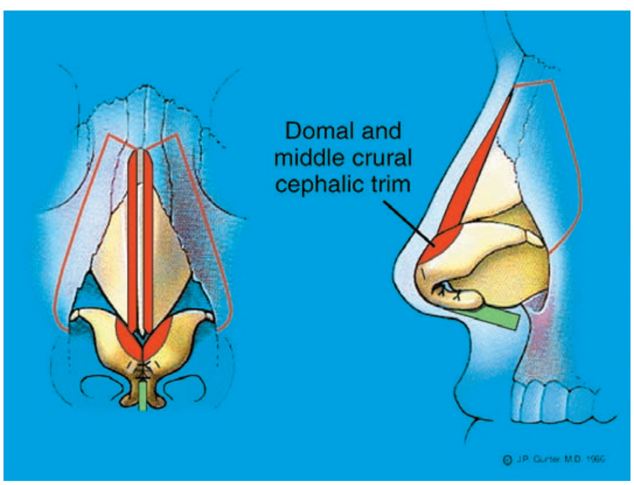
A final intraoperative assessment is made to check for excessive lateral crural convexity or concavity. If either is present, it is corrected by alar contour grafts[29] or lateral crural strut grafts.[31] Alar contour grafts are primarily used to reshape the alar rim by nonanatomic placement along the alar rim. Lateral crural strut grafts are used to reshape or reposition the lateral crura.

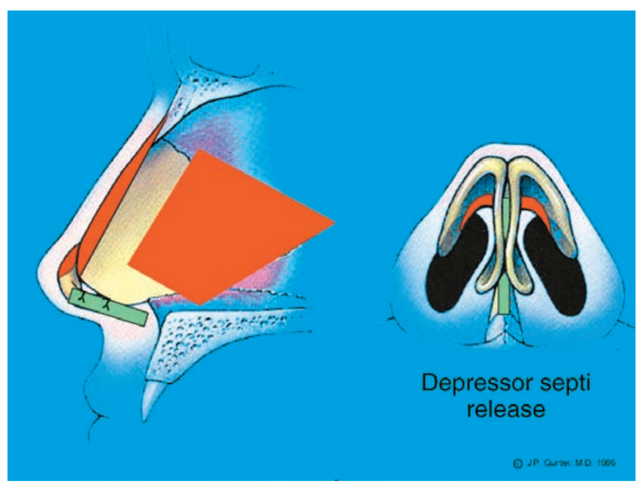
A final intraoperative assessment is made to check for excessive lateral crural convexity or concavity; if either is present, alar contour grafts or lateral crural strut grafts are required to correct the deformity.

CASE ANALYSES



This 24-year-old woman requested only that her boxy tip be corrected. She had no symptoms of nasal airway obstruction, no history of allergies, and no history of nasal trauma. Examination revealed good dorsal aesthetic lines and no dorsal hump. She had asymmetrical fullness of the supratip area as a result of the malpositioned boxy tip. The left lower lateral cartilage was more obliquely rotated than the right. She had an excess lateral alar convexity with preoperative alar notching that contributed to alar notching in the midalar area.



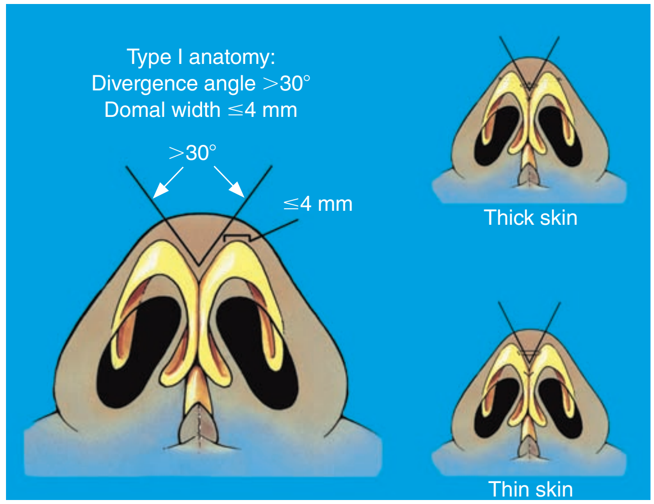


Surgical Plan

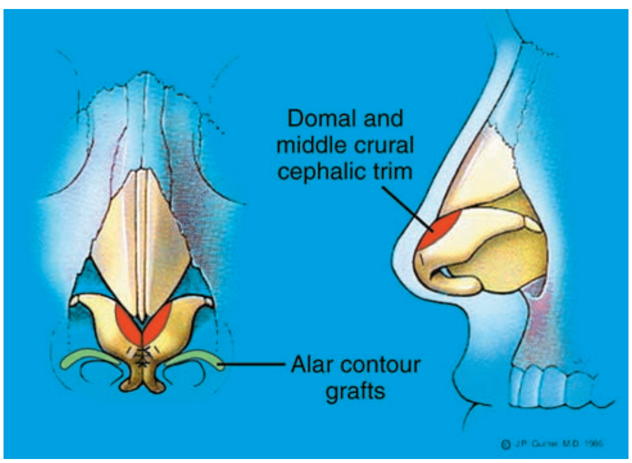
1. Perform an open rhinoplasty.
2. Place intercrural sutures to stabilize the medial crura of the lower lateral cartilage.
3. Use interdomal and transdomal sutures to correct the boxy tip.

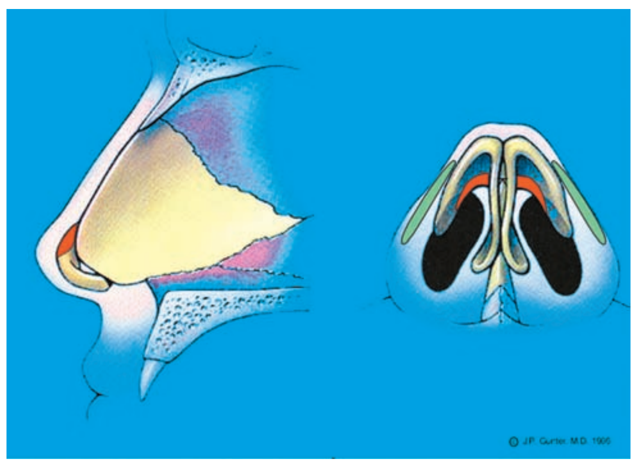
4. Perform cephalic trim of the lateral and middle crura, leaving 6 mm of lower lateral cartilage.
5. Use bilateral alar contour grafts to correct alar notching.
6. Perform depressor septi nasi release.

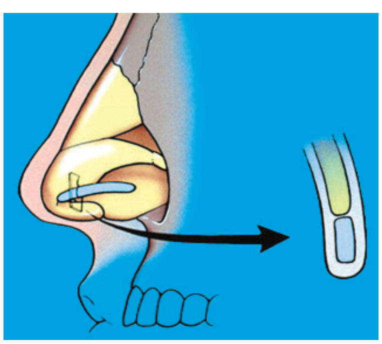
Postoperatively the improvement of the dorsal aesthetic lines, nasal facial balance, and refinement and correction of the nasal tip and dorsal hump is evident. The basal view demonstrates the correction of the boxy tip. There is slight alar collapse and medial crural deviation.



This 18-year-old patient with thick skin had an increased domal arch with a normal angle of divergence. She had a history of nasal airway obstruction, more on the left than the right, and no history of nasal trauma. Her chief complaints were her wide nasal base, isometric dorsum, and bulbous, boxy tip. She requested correction of the bulbous tip.



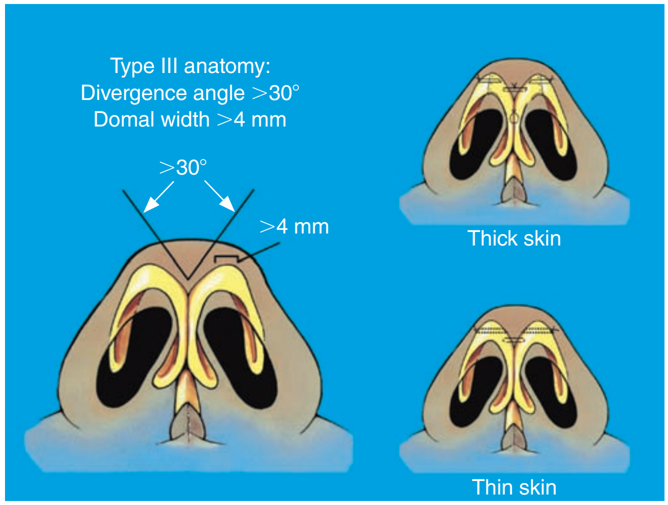




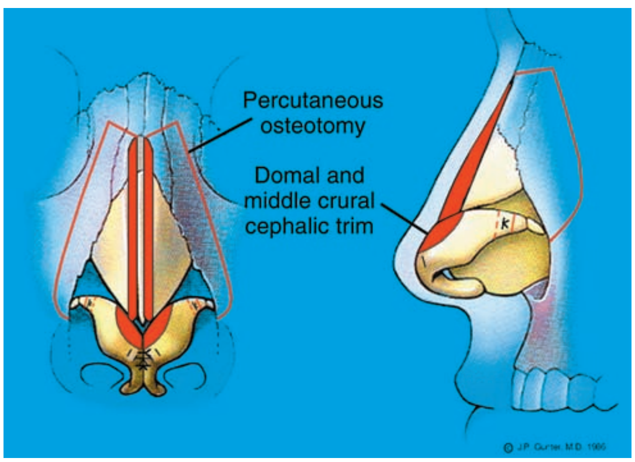
Surgical Plan

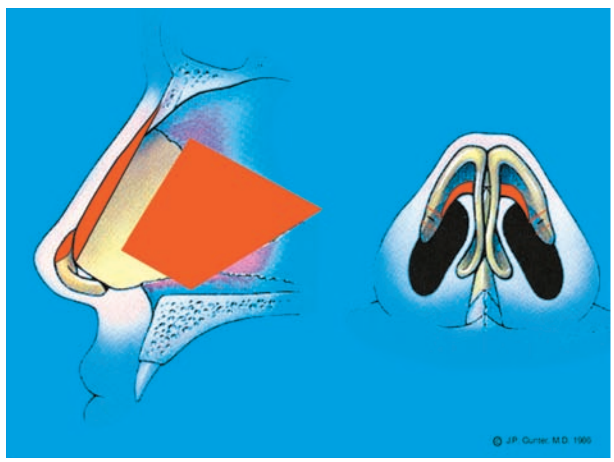
1. Perform an open rhinoplasty.
2. Reconstruct the septum and harvest septal cartilage.
3. Reduce the dorsum by 3 mm.
4. Place intercrural sutures to stabilize the columellar strut graft.
5. Use interdomal and transdomal sutures to correct the boxy tip.
6. Perform cephalic trim of the lateral and middle crura, leaving 6 mm of lower lateral cartilage.
7. Perform percutaneous perforated osteotomies.

Fifteen months postoperatively, the patient shows improved nasal dorsal aesthetic lines as well as correction of the boxy tip and the lateral alar convexity with the placement of alar contour grafts.



This 50-year-old man had a history of nasal trauma as well as septal nasal airway obstruction. He requested nasal airway correction and correction of his boxy tip. He had thick skin and widened dorsal aesthetic lines, along with a wide nasal base and boxy tip. An increased angle of divergence and an increased domal arch were noted and confirmed intraoperatively.





Surgical Plan

1. Perform an open rhinoplasty.
2. Perform cephalic trim of the lateral and middle crura, leaving 6 mm of lower lateral cartilage.
3. Reconstruct the septum and harvest septal cartilage.
4. Place a columellar strut graft secured with intercrural sutures.
5. Place interdomal sutures and perform peridomal transection, overlaying with horizontal mattress sutures, and place a transdomal suture (5-0 PDS).
6. Perform a component dorsum reduction of 3 mm.
7. Perform percutaneous perforated osteotomies.

The patient is shown 2 years postoperatively, demonstrating correction of the dorsal aesthetic lines and nasal base, improvement of the nasal-facial balance, and correction of the boxy tip.

KEY POINTS

- The operative goal is to reposition the tip-defining points, angulate the domes, and shape the lateral crura.
- With careful preoperative and intraoperative analysis, a variety of potentially reversible reshaping suture techniques, and an individualized algorithmic approach, the boxy tip can be accurately and consistently corrected.

- The transection and resection techniques used initially have been replaced with cartilage conservation and suturing.
- Alar cartilage suturing, scoring, transection, and cephalic trim, individually or in various combinations, are satisfactory for correcting the vast majority of boxy nasal tips.
- Long-term complications of notched alar rims, pinched tips, alar collapse, asymmetry, and reduced intrinsic tip support limit the usefulness of alar cartilage transection and resection.
- Lower lateral crural cartilage scoring weakens the alar rim strip and may decrease tip projection.
- Lower lateral crural cartilage scoring is generally limited to thick-skinned patients with resilient lower lateral cartilages.
- Cephalic trim not only reduces tip fullness but also decreases the distance between the tip-defining points.
- It is essential for the lower lateral cartilages to be strong and resilient, otherwise cephalic trim may lead to loss of support to the nasal tip or alae. In this case, performing lower lateral crural turnover flaps will result in reducing tip fullness while preserving the intrinsic support of the lower lateral cartilages.
- Excision of the cephalic margin removes the attachments between the lower and upper lateral cartilages at the scroll area and can affect both tip projection and rotation.
- Suturing techniques leave the alar rim strip intact. In addition, they are incremental, precise, and reversible. We prefer the open rhinoplasty approach and use long acting, absorbable 5-0 PDS sutures when refining the nasal tip.
- Suture techniques, unlike cartilage scoring or resection, have the distinct advantage of being nondestructive, incremental, and reversible.
- We frequently place alar contour grafts to strengthen the alar rims and prevent alar deformities including alar collapse, notching and retraction.
- Although techniques to correct the boxy tip by recontouring of the nasal skin and soft tissues has been described, extensive defatting of the nasal skin may injure the subdermal plexus and jeopardize blood supply to the nasal tip. For this reason, these techniques should be avoided.
- The intraoperative analysis confirms and clarifies the specific anatomic type, specifically whether the boxy tip is the result of an increased angle of divergence, a widened dome arc, or a combination of the two.
- The preoperative and intraoperative assessment includes skin thickness, the dome arc width, and the angle of divergence.
- Despite the dramatic effects of scoring and transection, these techniques irreversibly disrupt the structural integrity of the alar rim strip and can reduce tip support and projection.
- A final intraoperative assessment is made to check for excessive lateral crural convexity or concavity; if either is present, alar contour grafts or lateral crural strut grafts are required to correct the deformity.

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23

Predictable Control of Tip Projection and Rotation: Septal Extension Grafts

Rod J. Rohrich ▪ Jamil Ahmad ▪ T. Jonathan Kurkjian ▪ H. Steve Byrd

Predictable control of nasal tip projection and rotation is one of the most challenging aspects of rhinoplasty. Multiple anatomic structures contribute to nasal tip projection and rotation including the septum, the upper and lower lateral cartilages and the soft tissue connections between these structures.[1] During rhinoplasty, maneuvers that reduce, weaken, or disrupt these structures will lead to loss of tip projection and/or rotation.

Factors That Determine Tip Projection and Rotation

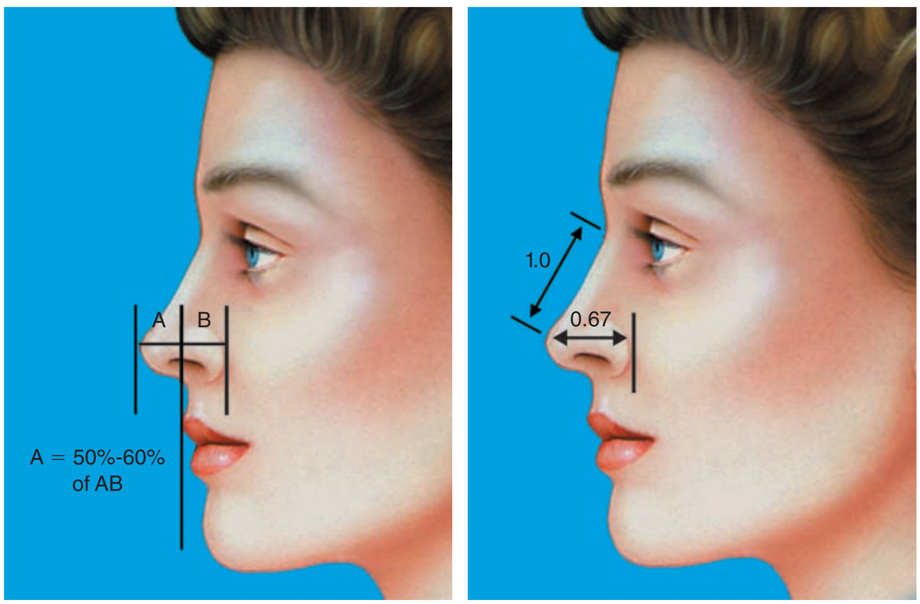
- Length, width, and strength of the lower lateral cartilages
- Length and stability of the medial crus
- Suspensory ligament that spans the crura over the anterior septal angle of the upper and lower lateral cartilages
- Fibrous connections between the upper and lower lateral cartilages
- Abutment with the piriform aperture
- Anterior septal angle
- Skin and soft tissue thickness and availability

Multiple anatomic structures contribute to nasal tip projection and rotation.

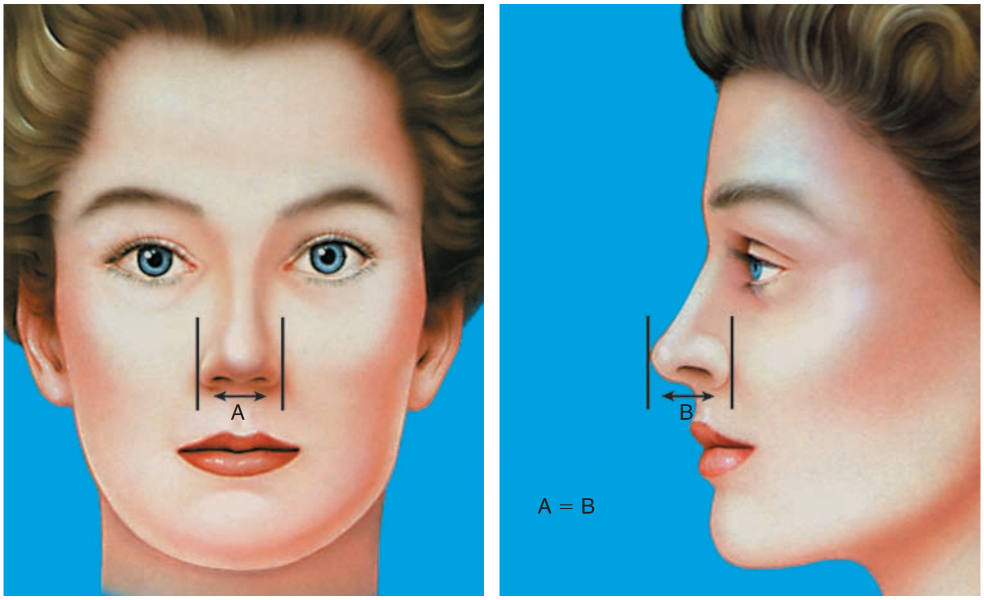
Various techniques have been described to increase tip projection and/or rotation, including nasal tip suturing and the addition of various grafts to strengthen or lengthen the nasal tip complex. In this chapter we will review the role of septal extension grafts in altering tip projection and rotation.

ASSESSING TIP PROJECTION AND ROTATION

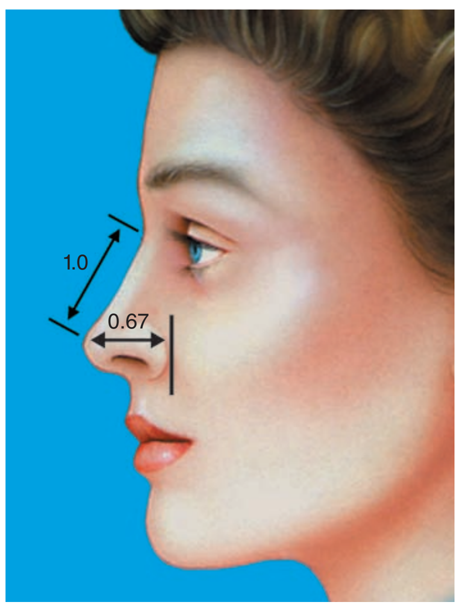
In addition to tip symmetry, adequate tip projection and rotation contributes significantly to nasal balance and aesthetics.



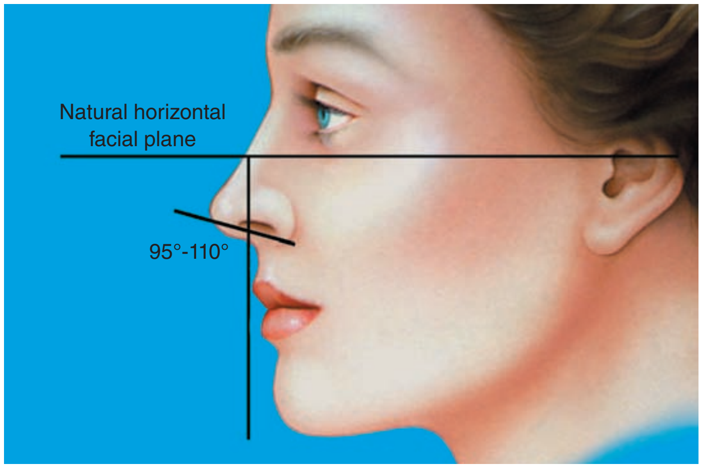
Several methods have been used to assess whether tip projection is ideal. Tip projection can be evaluated by drawing a horizontal line from the alar-cheek junction to the tip of the nose and a vertical line tangential to the most projecting portion of the upper lip. At least half of the horizontal line should lie anterior to the vertical line for tip projection to be considered adequate. If more than 60% of the horizontal line is anterior to the vertical line, the tip is overprojecting.



Tip projection should also be proportional to the alar base width.



Tip projection has also been described relative to nasal length. Nasal tip projection should be equal to two thirds of the distance from the radix to the nasal tip.[2]



Tip rotation is determined by the nasolabial angle. This is determined by drawing a line through the most anterior and posterior points of the nostrils. The angle that exists between this line and the line perpendicular to the natural horizontal facial plane is considered the nasolabial angle. In women, the ideal angle ranges from 95 to 110 degrees; in men, it should be closer to 90 degrees.

FACTORS THAT DECREASE TIP PROJECTION AND/OR ROTATION

Standard techniques to refine and reposition the nasal tip such as transfixion incisions, intercartilaginous incisions with cephalic trim of the lower lateral cartilages, dorsal and caudal septal reduction, division of the suspensory ligament, and division of the lower lateral cartilages or their connections to the piriform aperture all contribute to loss of tip support. Loss of tip support may manifest as loss of tip projection and/or rotation.

Loss of tip support may manifest as loss of tip projection and/or rotation.

In a prospective study by Rich et al,[3] loss of tip projection was confirmed in 100 consecutive patients after rhinoplasty. Petroff et al[4] also showed an inability to maintain tip projection after rhinoplasty. Specifically, their study associated transfixion incisions and the subsequent release of the medial crura from the septum as the most significant cause of nasal tip deprojection. It is thus imperative that the rhinoplasty surgeon be able to employ various techniques to counter this tendency for nasal tip deprojection.

We performed a multivariate analysis of maneuvers in 125 patients to determine which measures had the greatest effect on tip deprojection.[5] Component dorsal hump reduction and caudal septal resection had the greatest effect. From these findings, we propose that release of the soft tissue attachments of the lower lateral cartilages and modification of the anterior septum are frequently sufficient to achieve a satisfactory aesthetic endpoint.

Release of the soft tissue attachments of the lower lateral cartilages and modification of the anterior septum are frequently sufficient to deproject the nasal tip.

A moderate decrease in tip projection can be achieved without aggressive cartilage transection techniques in the vast majority of cases. Instead of proceeding directly to cartilage division, the surgeon should address the various soft tissue supports of the nasal tip sequentially to produce a gradual, controlled alteration of the nasal tip.

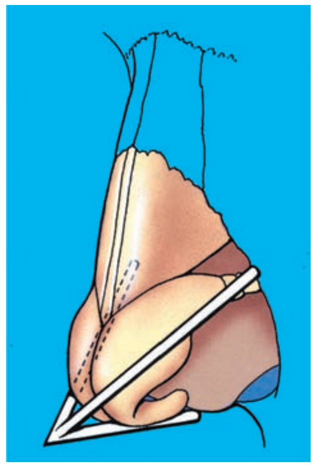
A moderate decrease in tip projection can be achieved without using aggressive cartilage transection techniques.

From this study, we proposed an algorithm for tip deprojection[5]:

1. Open approach with full exposure of all cartilages
2. Intercartilaginous incision or cephalic trim
3. Full dissection of medial crura and footplates
4. Anterior septal reduction with or without dorsal reduction or caudal septal resection as needed
5. Dissection of lateral crura and accessory cartilages
6. Division of the accessory cartilages of the lower lateral cartilage
7. Setback with overlap of cartilage rather than excision; secured with horizontal mattress sutures
8. Transection 2 mm posterior to the junction of the medial and intermediate crura
9. Setback with cut medial crus falling under the domal cartilage; secured with horizontal mattress sutures
10. Alar base resection as needed
11. Membranous columella resection as needed

TECHNIQUES TO INCREASE TIP PROJECTION AND/OR ROTATION

Various techniques have been described to increase tip projection and/or rotation including nasal tip suturing and the addition of various grafts to strengthen and/or lengthen the nasal tip complex (see Chapters 17 through 22). Nasal tip suturing techniques and tip grafting can increase tip projection by 1 to 3 mm.



Anderson described the tripod concept to relate nasal tip support and shape to the paired lower lateral complexes.[6] Each complex consists of a medial crus (which includes the middle crus) and a lateral crus. These paired complexes can be visualized as a tripod, with each lateral crus forming a separate lateral cephalic leg, and the adjoining medial crura forming the third caudal leg.[7] Tip position can be changed by modifying medial and lateral crural support. Both columellar strut grafts[8,9] and lateral crural strut grafts[10] have been used to increase tip projection and/or rotation. The utility of lateral crural strut grafts are discussed in detail in Chapter 29.

Columellar strut grafts have long been employed as a means to increase nasal tip projection. In a more recent study by Rohrich et al,[8,9] however, 100 consecutive patients who underwent primary rhinoplasty with the use of a columellar strut were analyzed. Based on computer analysis of preoperative and postoperative photographs, 65% of these patients actually lost tip projection despite the use of a columellar strut. Of note, these struts were floating and not fixed, reflecting the clinical reality in which the septal cartilage provides a graft that is usually of inadequate length to span the distance from the maxilla to the nasal tip. Moreover, long columellar struts are often problematic because of their tendency to sublux on the nasal spine, creating an audible click or pain with nasal motion. As opposed to increasing tip projection, columellar strut grafts appear to have more effect on maintaining tip projection and unifying the tip complex.

As opposed to increasing tip projection, columellar strut grafts appear to have more effect on maintaining tip projection and unifying the tip complex.

Byrd et al[11] reported similar findings regarding the limitations of the columellar strut graft. They reviewed 20 patients identified as high risk for loss of nasal tip projection. In 19 patients, floating columellar strut grafts were placed under tension in an intercrural pocket, and one was anchored to the caudal septum. All 19 of these patients had loss of tip projection ranging from 0.5 to 2 mm. In the patient in whom the columellar strut had been affixed to the caudal septum, tip projection was maintained. The authors noted that columellar struts directly abutting the maxilla can reliably maintain nasal tip projection, but those struts require 28 to 30 mm of cartilage.

Based on their experience, Byrd et al stated that septal extension grafts were a more reliable method of controlling tip projection than columellar strut grafts. They found that it is possible to control the projection, rotation, and shape of the tip by securing the nasal tip with cartilage affixed to the septum through a septal extension graft. The site of fixation of the graft to the septum varies according to the status of the midvault, the stability of the septum, and the amount of available cartilage. The distance the graft extends beyond the septum is determined by the thickness of the overlying skin.

Projection, rotation, and shape of the tip can be controlled by securing the nasal tip to the septum using a septal extension graft.

Because dorsal and caudal septal reduction has the greatest effect on tip deprojection, creating structural support for the tip complex based on the anterior septum will allow predictable control of tip projection and/or rotation. Septal extension grafts use the stability of the septum to provide support for the tip complex.

Because dorsal and caudal septal reduction has the greatest effect on tip deprojection, creating structural support for the tip complex based on the anterior septum will allow predictable control of tip projection and/or rotation. Septal extension grafts use the stability of the septum to provide support for the tip complex.

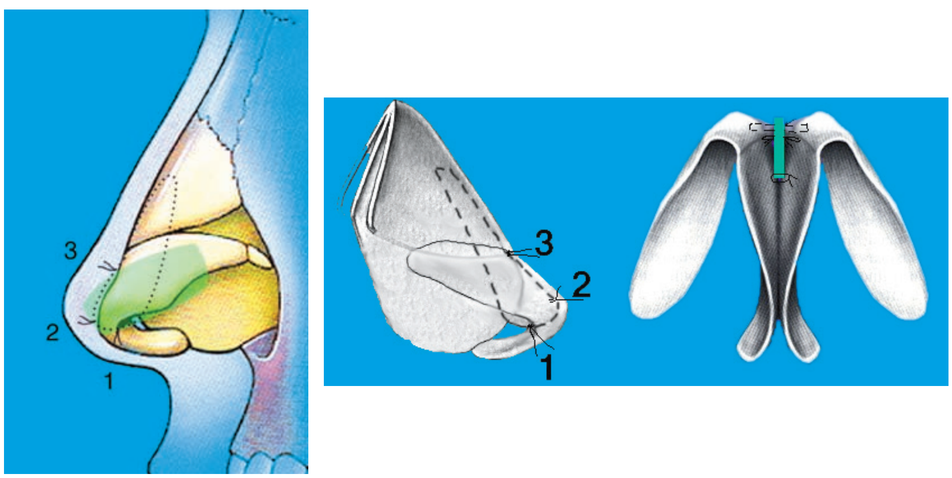
Although there are several types of septal extension grafts that differ in their shape and points of fixation to the septum, they have similar points of fixation in

the tip-lobule complex. Accurate suturing of the graft to the tip ensures control of projection, rotation, and shape of the lower lateral cartilage.

The points of fixation of septal extension grafts to the tip-lobule complex are similar, although the grafts have different points of fixation along the septum.

SEPTAL EXTENSION GRAFTS

Byrd et al[11] described three types of septal extension grafts aimed to enhance structural support of the tip through attachments to the septum. All three grafts depend on the presence of a stable caudal septum and differ only in points of fixation along the septum. The points of fixation to the septum vary according to the status of the midvault, stability of the septum, and amount of available cartilage. The distance the graft extends beyond the dorsal septum is determined by the thickness of the overlying skin. To create a supratip break, the tip-defining points of the domes should be 6 to 10 mm beyond the plane of the dorsum, depending on the thickness of the soft tissues. The upward angle of the graft is often 45 degrees, and the length of the tip portion averages 6 mm.



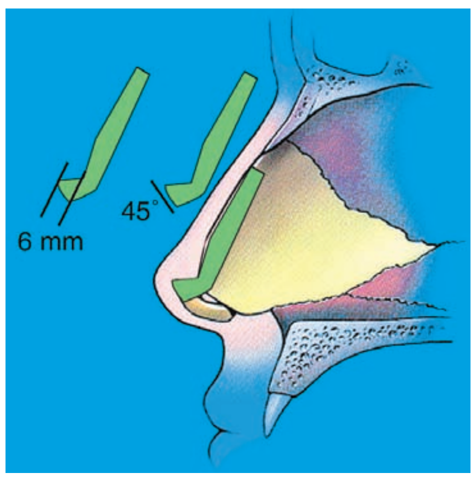
The septal extension graft extends beyond the anterior septal angle into the interdomal space.[11] The most caudal and inferior portion of the graft is placed on the cephalic border of the medial crus at the columellar-lobular angle. This point of fixation *(1)* is inferior to the divergence of the middle crura at a point where the cephalic borders of the medial crura abut one another. At this point, the graft incorporates the desired columellar-lobular angle. At its point of maximal projection between the domes, a point of interdomal fixation *(2)* is used to control the exact interdomal distance and projection. Fixation *(3)* of the graft to the lower

lateral cartilage should produce a differential between the domes and the nasal dorsum to produce the desired amount of supratip break.

Septal extension grafts are not indicated in patients who have heavy lower lateral cartilages and normal or excessive tip projection.[11] Noses that do not require septal extension grafts are characterized by normal or excessive tip projection, a slight elevation or accentuation of the tip above the supratip plane, adequate nasal length, normal alar arches, and thin skin cover. Nevertheless, even in these noses, care should be taken to avoid disrupting the alar arches and weakening the lower lateral cartilage during rhinoplasty. Suture techniques that enhance structural support of the dome should be used in all cases.

Septal extension grafts are not indicated in patients who have heavy lower lateral cartilages and normal or excessive tip projection.

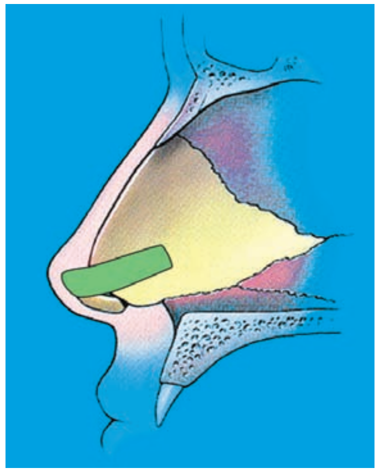
Type I Paired Extended Spreader Grafts



Paired extended spreader grafts are used to simultaneously address problems with the internal nasal valves and/or midvault width while altering tip projection and rotation. These grafts are placed at the junction of the upper lateral cartilage and septum and lie parallel to the nasal dorsum.[11] Extended spreader grafts require a distal segment that extends vertically beyond the level of the dorsum in order to increase tip projection. The tip-lobule complex is sutured to the graft to establish the appropriate tip projection or rotation.

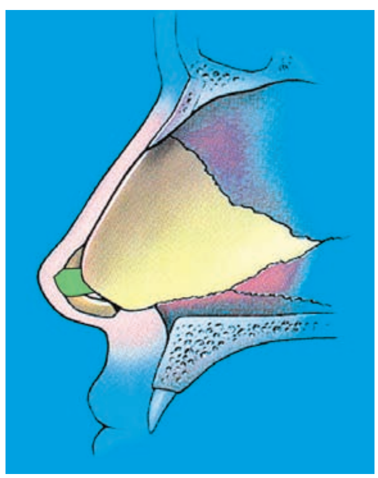
Paired extended spreader grafts are used to address problems with the internal nasal valves and/or midvault width while altering tip projection and rotation.

Type II Paired Septal Batten Grafts

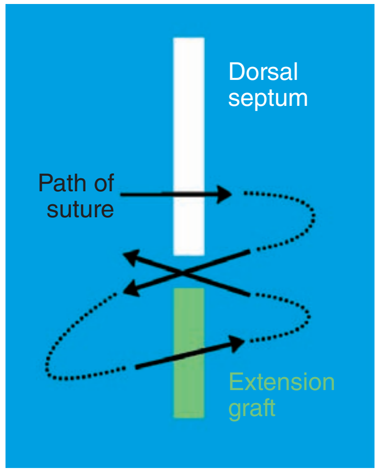


Paired septal batten grafts consist of paired grafts extending diagonally across the caudal and dorsal L-strut of the septum.[11] The grafts are placed below the junction of the upper lateral cartilage with the septum. Septal batten grafts differ from spreader grafts in that they do not affect the internal valve or the width of the midvault. These grafts require significantly less cartilage than paired extended spreader grafts.

Type III Direct Septal Extension Grafts



A direct septal extension graft is used when there is a limited amount of septal cartilage.[11] The graft is affixed directly to the anterior septal angle with figure-of-eight sutures at three points: from the bottom of the graft to the caudal septum, from the graft to the anterior septal angle, and from the graft to the dorsal abutment with the septum.



True figure-of-eight sutures are necessary to anchor the C-shaped graft securely to the anterior and caudal septum. The direct extension variety of septal extension graft is not indicated for tip asymmetries or deviations because it is less stable and more susceptible to shifting from the midline than the other two types.

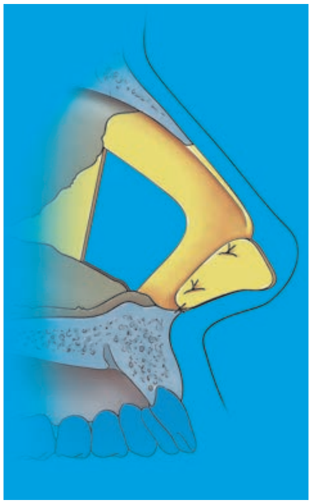
In addition to the three types of septal extension grafts described by Byrd et al, several other variations of septal extension grafts have been described.

Unilateral Septal Batten Graft

A unilateral septal batten graft can be used to control tip projection and rotation. It requires less cartilage than paired septal batten grafts but can be made larger to allow for better suture fixation to the anterior septum. Since this graft is placed only on one side of the septum, it will form a point of fixation for the tip off the midline and can produce deviation of the tip complex relative to the dorsum. This can be avoided by designing the unilateral septal batten graft using its intrinsic curvatures to position its anterior most projecting border in the midline. However, this same characteristic makes a unilateral septal batten graft particularly useful in cases of tip deviation secondary to the anterior septum. This graft can be used not only to straighten and support anterior septal deviations but also to fix the nasal tip complex more to one side of the nasal septum to compensate for nasal tip deviations.

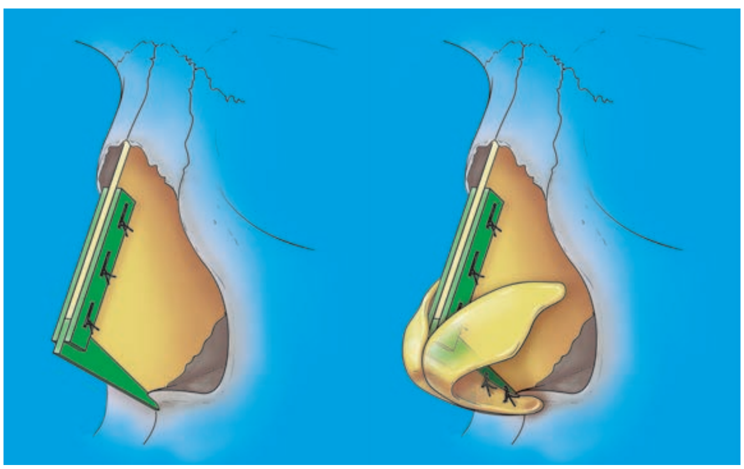
Since this graft is placed only on one side of the septum, it will form a point of fixation for the tip off the midline and can produce deviation of the tip complex relative to the dorsum.

Caudal Extension Graft



Toriumi[12-14] described the use of a caudal extension graft for cases in which the caudal septum is deficient, as seen with a foreshortened nose or columellar retraction. Placement of this graft can increase tip support, projection, and rotation and alter the alar-columellar relationship. The graft is usually rectangular and should overlap the caudal septum by 3 to 4 mm for maximal support. The graft is sutured to the caudal septum and then the medial crura are sutured to the caudal margin of the graft. Slight curvatures of the cartilage are used to position the caudal margin of the graft in the midline. The shape of the graft and its positioning will alter the tip position, nasolabial angle, and alar-columellar relationship.

Tongue-and-Groove Technique



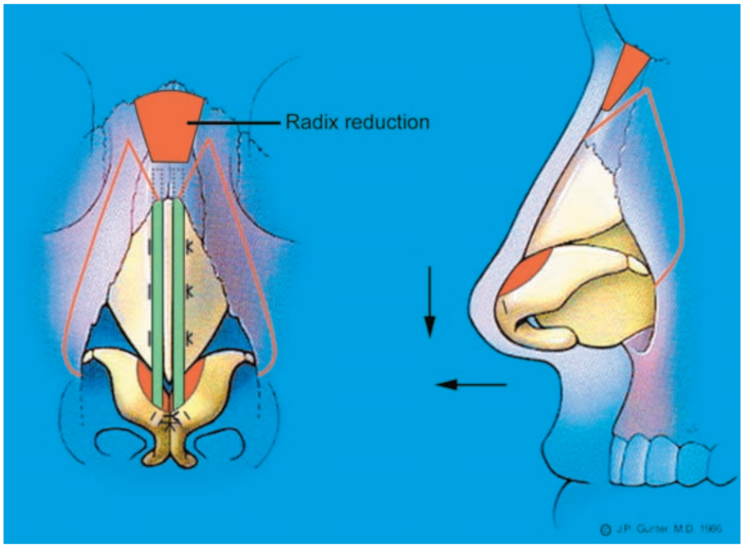
Guyuron and Varghai[15] described the tongue-and-groove technique as an effective method with which to create and maintain tip projection when nasal lengthening is also required.[16] Bilateral spreader grafts that extend beyond the caudal septum are sutured to the septum, and a columellar strut graft is positioned within the groove created by the spreader grafts. The total construct can be used to project the nasal tip, even beyond what is possible with a septal extension graft alone. This technique requires an exceptional amount of cartilage, which is often not available from the septum in a secondary rhinoplasty. Rib cartilage is usually required to fashion these grafts.

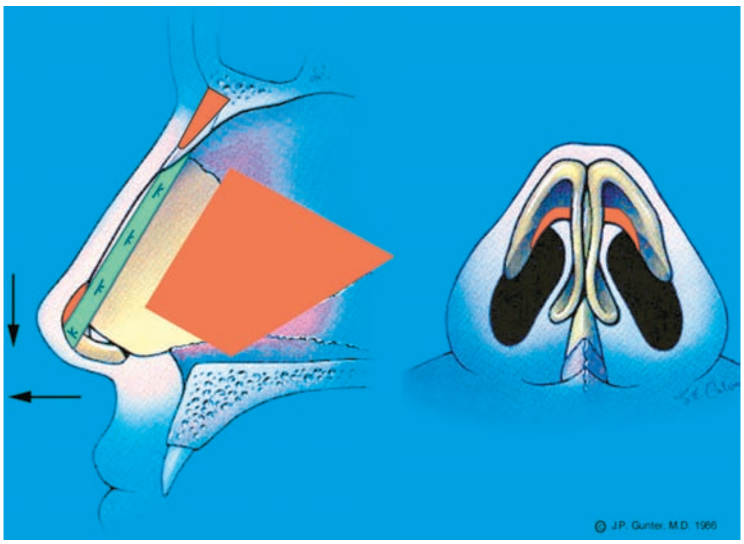
CASE ANALYSES

This 19-year-old woman expressed dissatisfaction with the appearance of her nose and complained of nasal airway obstruction. She was otherwise healthy and had no past medical or surgical history. She denied any history of facial trauma. Clinical analysis revealed a good facial profile and facial proportions, moderately thick nasal skin, wide dorsal aesthetic lines with a broad nasal base, bulbous nasal tip, high radix with short nose, and inadequate tip projection.

The operative goals included the following:

- Lengthen the nose.
- Increase tip projection.
- Narrow dorsal aesthetic lines.
- Refine and correct the bulbous nasal tip.

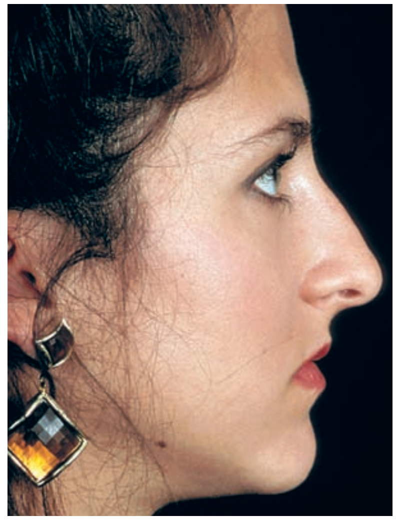




Surgical Plan

1. Use an open approach with a transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Lower the radix using a burr.
3. Correct the slightly deviated nasal septum and harvest septal cartilage, leaving an L-strut.
4. Lengthen the nose using bilateral extended spreader grafts.
5. Perform wide undermining of the nasal tip skin and release the lower lateral cartilages from their attachments to the upper lateral cartilages.
6. Perform cephalic trim leaving a 6 mm alar rim strip.
7. Use interdomal and transdomal suturing to refine the tip.
8. Perform percutaneous perforated lateral low-to-low and superior oblique osteotomies.

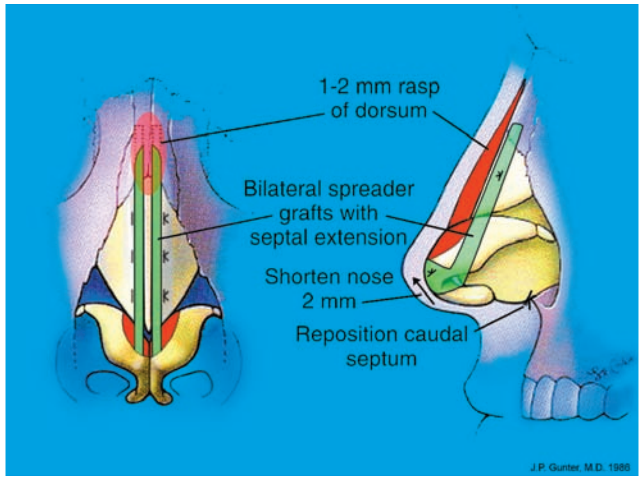
The patient is shown 8 years after surgery. Clinical analysis at this time revealed a normal radix, narrowed dorsal aesthetic lines, improved nasofacial balance, increased tip projection, increased nasal length, and refined nasal tip.

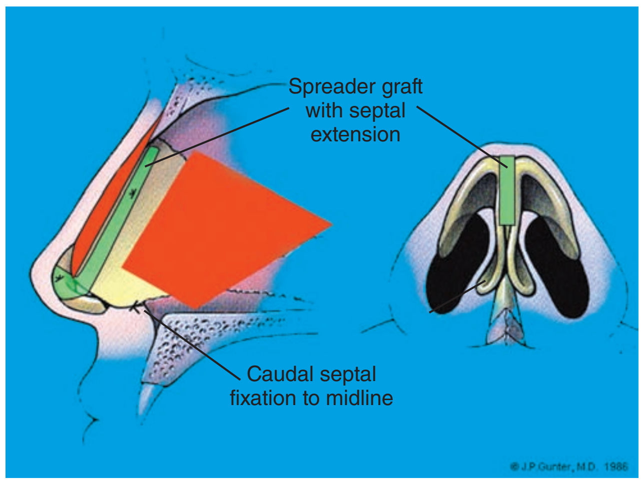




This 25-year-old woman had dorsal and caudal deviation, thin skin, and a tension midvault with primary inverted-V deformity.[11]

The operative goals included the following:

- Reduce the dorsal hump.
- Correct the dorsal and caudal septal deviation.
- Reconstruct the midvault deformity.
- Refine the tip.





Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform a component dorsal hump reduction (2 mm).
3. Reconstruct the septum, with harvest of the remaining cartilaginous and bony septum.
4. Reposition the caudal septum.
5. Use bilateral extended spreader grafts to control tip projection and rotation.
6. Perform bilateral cephalic trim for tip refinement.
7. Place interdomal and transdomal sutures to refine the tip.

The patient is shown postoperatively with a corrected dorsal hump, straightened septal deviation, restoration of middle vault with correction of the inverted-V deformity, increased tip projection and rotation, and tip refinement.[11]

KEY POINTS

- Multiple anatomic structures contribute to nasal tip projection and rotation.
- Loss of tip support may manifest as loss of tip projection and/or rotation.
- Release of the soft tissue attachments of the lower lateral cartilages and modification of the anterior septum are frequently sufficient to deproject the nasal tip.
- A moderate decrease in tip projection can be achieved without using aggressive cartilage transection techniques.
- As opposed to increasing tip projection, columellar strut grafts appear to have more effect on maintaining tip projection and unifying the tip complex.
- Projection, rotation, and shape of the tip can be controlled by securing the nasal tip to the septum using a septal extension graft.
- The points of fixation of septal extension grafts to the tip-lobule complex are similar, although the grafts have different points of fixation along the septum.
- Because dorsal and caudal septal reduction has the greatest effect on tip deprojection, creating structural support for the tip complex based on the anterior septum will allow the predictable control of tip projection and/or rotation. Septal extension grafts use the stability of the septum to provide support for the tip complex.
- Paired extended spreader grafts are used to address problems with the internal nasal valves and/or midvault width while altering tip projection and rotation.
- Septal extension grafts are not indicated in patients who have heavy lower lateral cartilages and normal or excessive tip projection.
- Since this graft is placed only on one side of the septum, it will form a point of fixation for the tip off the midline and can produce deviation of the tip complex relative to the dorsum.

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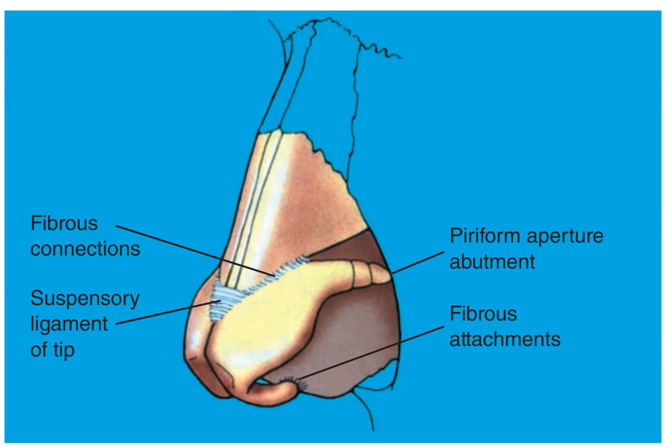
Decreasing Nasal Tip Projection: An Incremental Approach

C. Spencer Cochran ▪ Jordan J. Rihani ▪ Michael R. Lee ▪ Rod J. Rohrich

Achieving appropriate tip projection is one of the most important components of improving nasal aesthetics in rhinoplasty. Understanding the factors that contribute to tip support is paramount to successful deprojection of the nose in primary and secondary rhinoplasty. In this chapter, we present an incremental approach to decreasing tip projection.

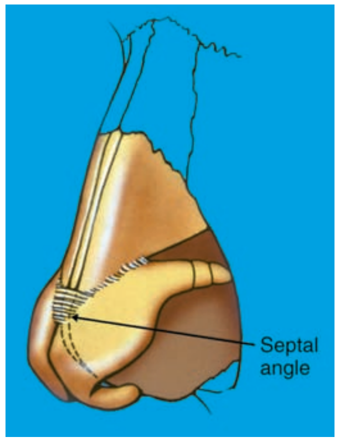
BACKGROUND

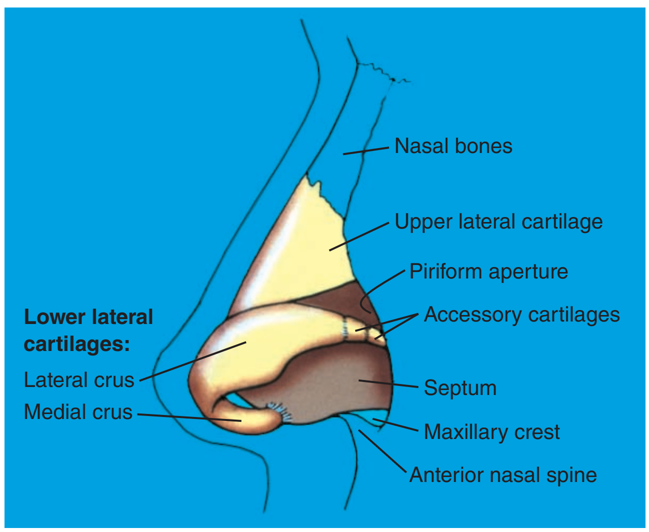


Tip projection depends on the following mechanisms of tip support:

1. Length and strength of the lateral crura
2. Length and strength of the medial crura
3. Anterior septal angle
4. Fibrous attachments connecting the feet of the medial crura to the caudal septum

5. Attachments between the lateral crura and the upper lateral cartilages at the scroll area
6. Interdomal ligaments connecting the cephalic margins of the domes
7. Nasal skin and soft tissue envelope

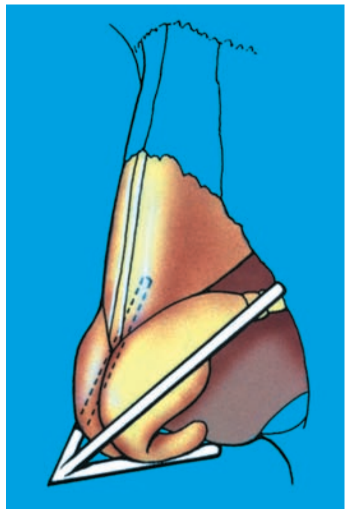




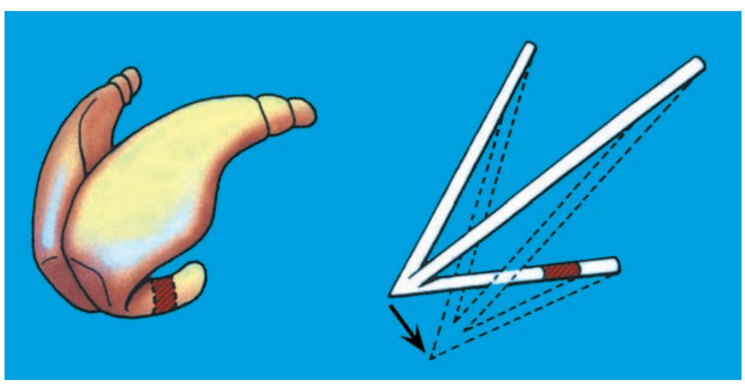
An overprojected tip may result from one or more of these factors, and the contribution of each tip support mechanism to tip projection varies from patient to patient. For example, in some patients with a tension nose deformity, a prominent anterior septal angle from an overdeveloped quadrilateral cartilage may be the major contributing factor to tip projection, while in other patients with large noses the overprojection may be primarily caused by excessive length or the strength of the lateral crura or medial crura.

For this reason, when planning tip deprojection, it is essential to consider the causes of overprojection as the operative plan is developed, and each factor must be assessed individually and addressed incrementally.[1-7]

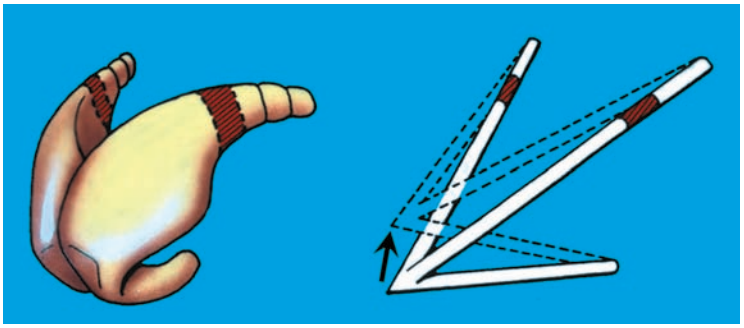
When planning tip deprojection, it is essential to consider the causes of over-projection as the operative plan is developed, and each factor must be assessed individually and addressed incrementally.



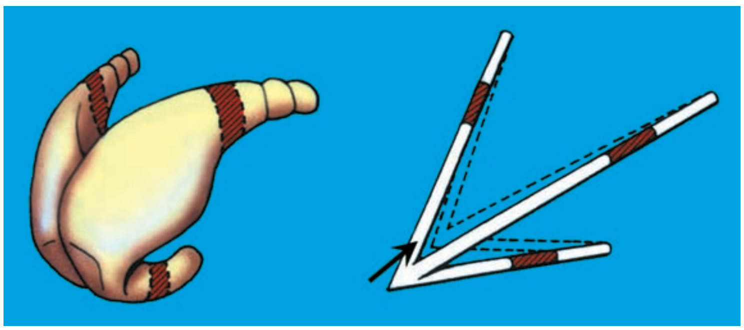
The tripod concept is a useful model for understanding the relationship between tip projection, rotation, and nasal length. This concept relates tip support to the paired medial crura–together forming the caudal leg of the tripod–and each lateral crus forming the individual cephalic legs of the tripod.



The tripod concept is important when considering deprojection maneuvers, because changes in the length of one leg of the tripod affect both projection and rotation. One can imagine shortening the medial crura, resulting in deprojection and derotation.



Meanwhile, shortening of the lateral crura will result in deprojection and rotation.



Shortening of both the medial and lateral legs of the tripod decreases the projection without affecting rotation.

INDICATIONS AND CONTRAINDICATIONS

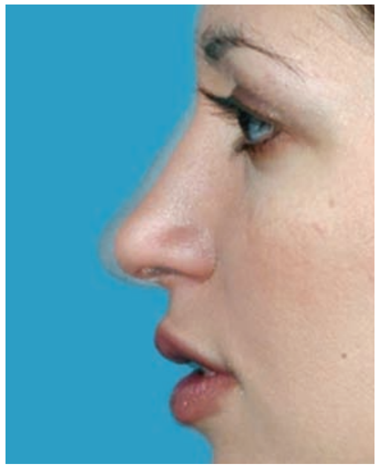
Nasal tip deprojection is indicated in patients with an overprojected tip. Although there are no absolute contraindications to decreasing tip projection, the surgeon should be mindful of the limitations of deprojection in a thick-skinned patient, because skin thickness is often the limiting factor in the amount of reduction possible.

The degree of achievable tip deprojection is limited in a thick-skinned patient, because thick skin has a limited ability to contract with the deprojected nasal tip framework.

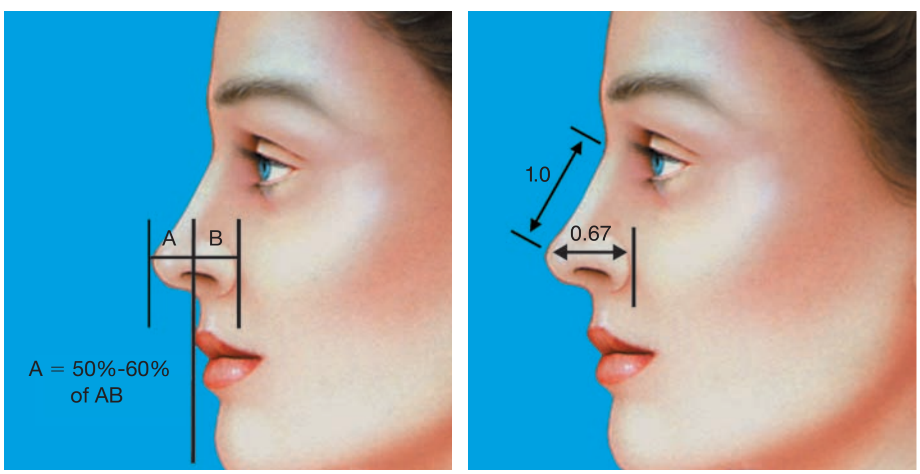
Patients with a low or deficient dorsum may have a false appearance of an overprojected nose. This dorsum-tip disproportion should be noted preoperatively and can be corrected by augmenting the radix rather than proceeding with inappropriate reduction rhinoplasty techniques.

PREOPERATIVE ASSESSMENT AND PLANNING

A thorough preoperative nasal examination and analysis of preoperative photographs should be performed. The desired tip projection should be determined in relation to the surrounding facial features.



By using computer morphing software or tracing paper on top of the preoperative photos, the surgeon can compare the preoperative tip projection with the desired tip position and estimate the amount of deprojection required to achieve the goal.[8]

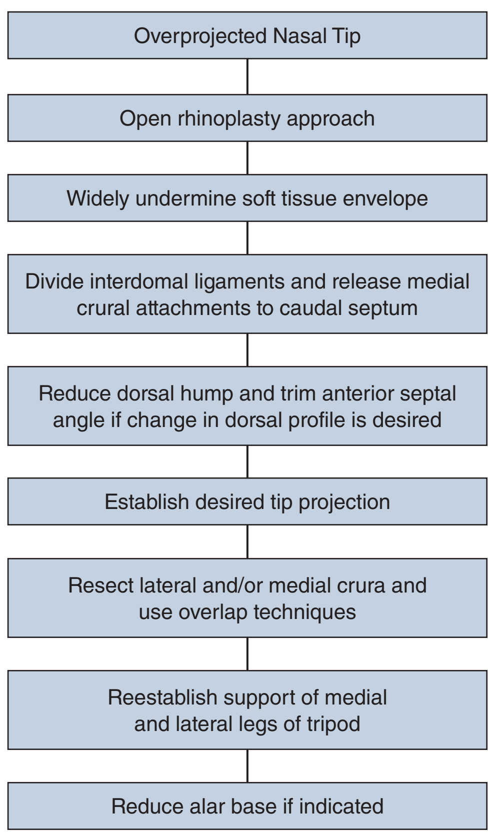


Various methods of determining nasal tip projection have been described. Byrd and Hobar[9] discussed nasal tip projection in the context of ideal nasal length (0.67 × midfacial height). In their method, the projection of the nose is then calculated as 0.67 × the ideal nasal length. The Goode method relies on drawing a line from the nasion through the alar crease. A line from there to the nasal tip is intersected with a line drawn from the nasion to the nasal tip. The ratio of

the horizontal line to the nasal dorsal line should be 0.55 to 0.60. One simple method is to draw a vertical line upward from the most anterior portion of the upper lip. Approximately 50% to 60% of the length from the alar facial groove to the nasal tip should fall anterior to the lip. A nose that projects more than 60% is considered overprojected. Another simple method is that the length of the upper lip should roughly equal the distance from the base of columella to the nasal tip. This last method assumes that the upper lip is of normal length and not distorted from a prominent nasal spine.

If preoperative analysis indicates that one of the goals of rhinoplasty is to decrease tip projection, the surgeon needs to be able to control the decrease incrementally, and a systematic and algorithmic approach should be followed. The key components of this approach are (1) determining the cause (or causes) of overprojection, (2) incrementally addressing each factor, (3) setting the desired tip projection, and (4) reestablishing support of each leg of the tripod.

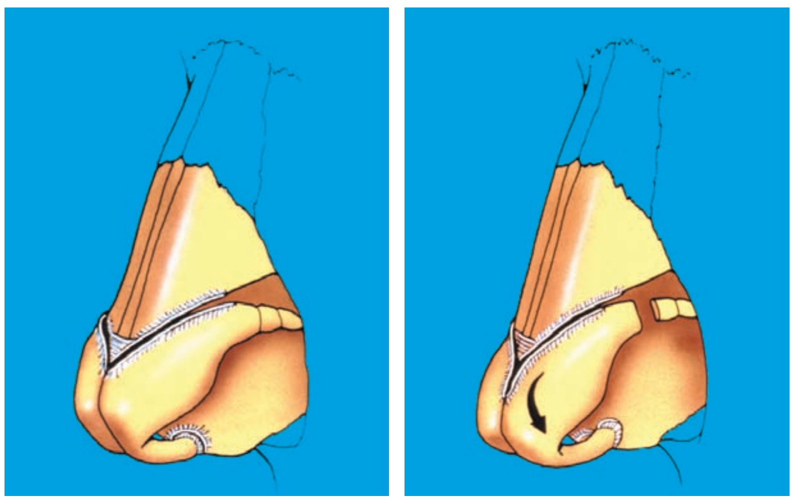
Incremental Approach to Decreasing Nasal Tip Projection



OPERATIVE TECHNIQUE

Because overprojection of the nasal tip usually is a consequence of a combination of the tip support mechanisms, we advocate a stepwise approach to addressing each factor through an open rhinoplasty approach, with redraping of the soft tissue envelope after each maneuver to assess the effect on the tip position.

A transcolumellar incision is created and connected with infracartilaginous incisions that follow the caudal border of the lateral crura. The nasal soft tissue envelope is elevated from the tip and nasal dorsum to expose the osteocartilaginous framework. The soft tissue envelope should be widely undermined from the lateral crura, because the destabilization of the nasal tip that occurs when the soft tissue envelope is elevated in the open approach allows a modest amount of deprojection.



Once the soft tissue envelope is elevated from the lower lateral cartilages, the interdomal and suspensory ligaments that traverse the septal angle are divided, and the ligamentous attachments between the lateral crura and the upper lateral cartilages along the scroll area can be severed. A similar effect is achieved with removal of the cephalic margin of the lateral crura.

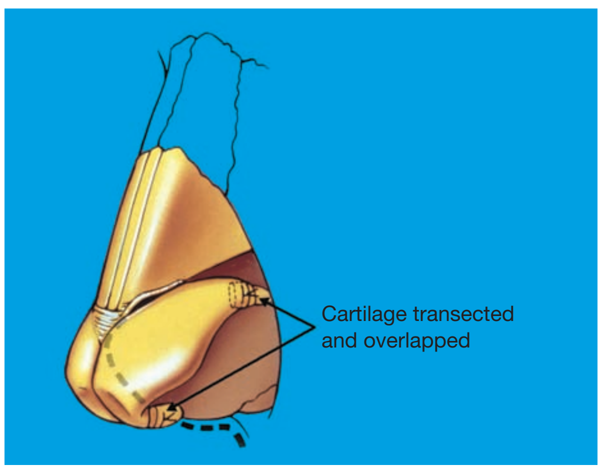
If additional deprojection is required, the fibroelastic attachments between the feet of the medial crura and the caudal septum should be released. This is accomplished after exposure of the anterior septal angle through division of the interdomal ligaments. Mucoperichondrial flaps are elevated and extended down

to the caudal septum and nasal spine to release the medial attachments. Alternatively, a full transfixion incision will effectively free the medial crura from the septum; however, this is usually unnecessary.

If a dorsal hump reduction is planned or if a supratip break is desired, the dorsal septum can then be judiciously trimmed. This can help prevent a pollybeak deformity resulting from excess dorsal septum in the supratip area.

When all other factors have been addressed and the desired decrease in tip projection still has not been achieved, the length and strength of the medial and/or lateral crura must be altered.

Changing the length of the lateral crura or medial crura can potentially affect rotation. If one performs resection of medial or lateral crura, suture lines should be concealed in the infratip lobule to avoid irregularity of the columella.



The lateral crura are usually altered first, because they often play a more significant role in tip support than the medial crura. First, the vestibular skin is undermined from the undersurface of the lateral crura just anterior to the lateral crus–accessory cartilage junction and the lateral crus is vertically transected to allow them to overlap. The tip is manually back to the desired position, overlapping the cartilages the desired amount, and the overlapping segments are sutured together. This maneuver is then repeated on the opposite side.

When transecting and overlapping the lateral crura, placement of lateral crural strut grafts can help prevent medial collapse of the lateral crus–accessory cartilage junction.

Supporting the area of overlap with lateral crural strut grafts may be required in patients with weak lateral crura to prevent external valve collapse. It is also important to note that when the length of the lateral crura are shortened but the medial crural length (or their attachments to the caudal septum) remain the same, there is a resulting upward rotation of the nasal tip.

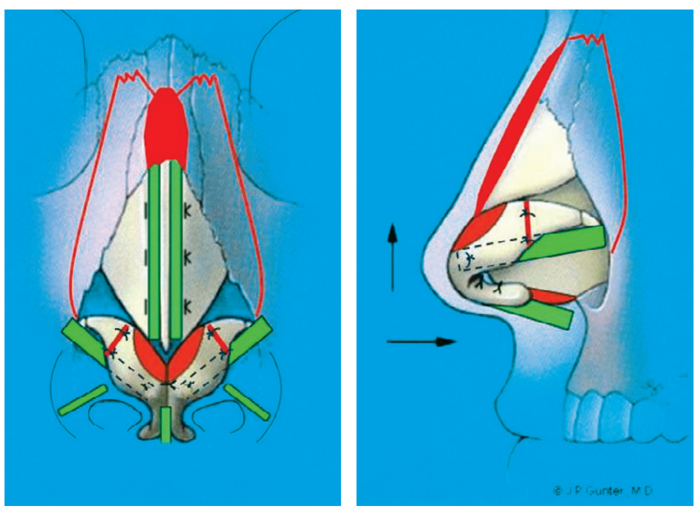
When the medial crura are excessively long and the medial crural footplates impede retrodisplacement of the nasal tip, the medial crural footplates can be dissected from beneath the columellar skin and trimmed the appropriate amount. The medial crura may also be shortened by undermining the vestibular skin from the crura anteriorly where they meet the middle crura. The middle crura can then be transected vertically, which will allow them to be segmentally resected or overlapped the desired amount. The overlapped segments are then sutured the together. Shortening the middle crura can move the tip-defining points downward, thereby decreasing the height of the infratip lobule. The medial crura should be stabilized on a columellar strut, whether they have been transected or not.

In thick-skinned patients, cautious debulking of the undersurface of the soft tissue envelope may be performed while taking care to preserve the dermis and subdermal plexus located in the subdermal fat. This can potentially allow additional deprojection and increased tip definition. Finally, alar base reductions may be performed to reduce flaring associated with deprojection.

Alar base reductions may be required to reduce alar flaring associated with deprojection.

CASE ANALYSES

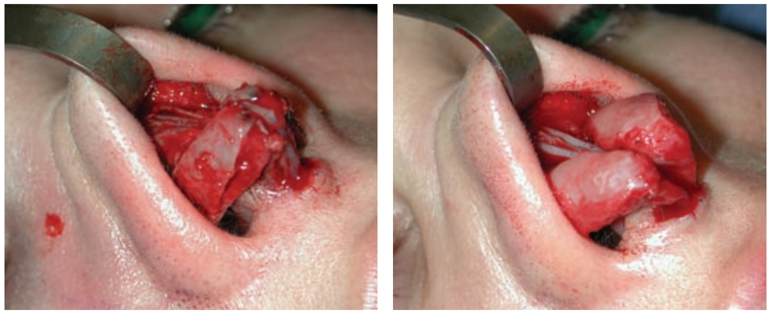
This primary rhinoplasty patient's preoperative photos depict the overprojection and underrotation of the nasal tip. The main causes of her overprojection were determined to be caused by excessive length of her lateral crura and a prominent dorsal septum.



The operative goals included the following:

- Perform open rhinoplasty.
- Release interdomal and suspensory ligaments and medial crura ligamentous attachments.
- Reduce the dorsal hump.
- Perform cephalic trim.
- Shorten the lateral crura with transection and resupport with lateral crural strut grafts.

Support the tip with a columellar strut graft.

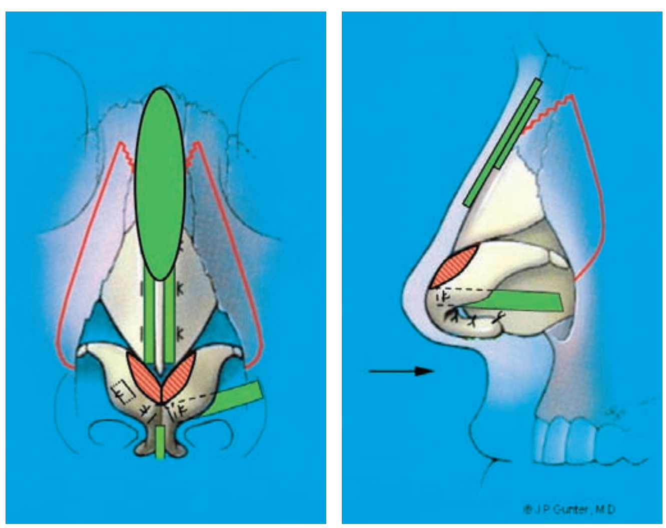


This intraoperative photo shows the upward rotation and deprojection of her tip using the above techniques.

Postoperative photos show increased tip rotation as well as deprojection of her tip to create a more balanced nose.

This secondary rhinoplasty patient with a low radix from an overly aggressive dorsal hump reduction demonstrates how dorsum-tip disproportion can give the illusion of an overprojected tip. She underwent a secondary open rhinoplasty with auricular cartilage graft and augmentation of her radix to improve the dorsal length to tip projection ratio.

Consider insufficient radix projection as a cause for dorsum-tip disproportion and a seemingly overprojected tip.



The operative goals included the following:

- Perform open rhinoplasty.
- Augment the dorsum to reposition the radix more superiorly.
- Support the tip with a columellar strut graft.
- Reconstruct the lateral crura with lateral crural strut grafts.

Postoperative photos show improved dorsum-tip proportion, creating a more balanced nose.

CONCLUSION

Multiple factors contribute to tip projection, and incrementally addressing these factors will allow the surgeon to decrease tip projection in a controlled manner. When the ligamentous attachments and fibroelastic attachments are eliminated, the main support to the tip comes from the length and strength of the lower lateral crura, especially with open rhinoplasty, where the support from the skin has been eliminated.

KEY POINTS

- When planning tip deprojection, it is essential to consider the causes of overprojection as the operative plan is developed, and each factor must be assessed individually and addressed incrementally.
- The degree of achievable tip deprojection is limited in a thick-skinned patient, because thick skin has a limited ability to contract with the deprojected nasal tip framework.
- Changing the length of the lateral crura or medial crura can potentially affect rotation. If one performs resection of medial or lateral crura, suture lines should be concealed in the infratip lobule to avoid irregularity of the columella.
- When transecting and overlapping the lateral crura, placement of lateral crural strut grafts can help prevent medial collapse of the lateral crus–accessory cartilage junction.
- Alar base reductions may be required to reduce alar flaring associated with deprojection.
- Consider insufficient radix projection as a cause for dorsum-tip disproportion and a seemingly overprojected tip.

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25

Adjusting Rotation of the Nasal Tip

Rod J. Rohrich ▪ Georges N. Tabbal ▪ T. Jonathan Kurkjian ▪ Jamil Ahmad

Nasal tip position depends on multiple structural components which influence one another through complex relationships. The dynamic nature of the nasal tip thus must be carefully considered as one formulates the operative plan. Adjusting tip rotation during rhinoplasty will be subjected to the sometimes unpredictable forces of scar contracture postoperatively. A graduated approach to alterations in tip rotation is essential for predictability and consistent results.[1-25]

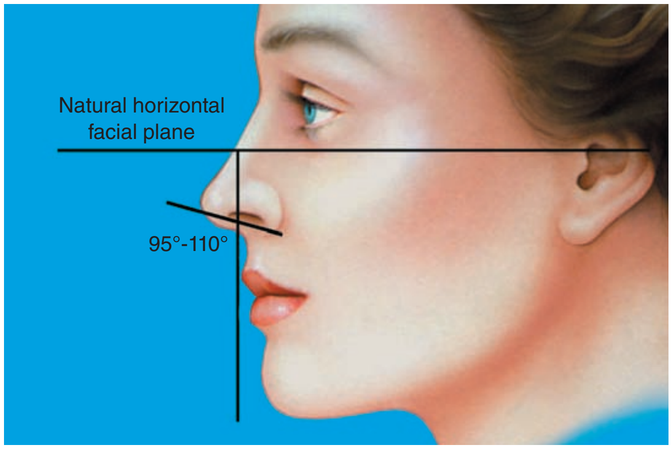
As with any rhinoplasty technique, success depends largely on accurate preoperative analysis and effective communication with the patient to determine precise operative goals.

In this chapter, clinical analysis, the relevant anatomy, and operative techniques for both increasing and decreasing tip rotation will be reviewed and discussed.

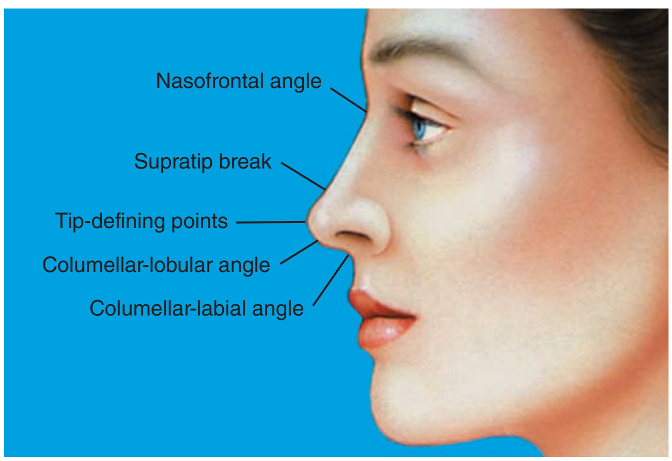
CLINICAL ANALYSIS

Effective control of nasal tip rotation begins first with analysis of tip position. Although several measurements have been described to help quantify this characteristic, the nasolabial angle remains the parameter of choice. It is measured by drawing a straight line through the most anterior and posterior points of the nostrils as seen on the lateral view. The angle this line forms with a perpendicular line to the natural horizontal facial plane is the nasolabial angle.

Nasal tip rotation should be analyzed by assessing the nasolabial angle, which should be 95 to 110 degrees in white women and 90 to 95 degrees in white men.



The ideal nasolabial angle is 95 to 110 degrees in white women and 90 to 95 degrees in white men. An increase in this angle results in an upward tilt of the base of the nose with a concomitant decrease in nasal length (distance between the nasofrontal angle and the tip-defining points) and increased nostril show on the frontal view. Conversely, patients with decreased nostril show on the frontal view, downward projecting nasal tips, and long noses have acute nasolabial angles.



Both the columellar-lobular and the columellar-labial angle contribute to nasal tip contour but do not objectively assess true tip rotation. For example, the columellar-labial angle is formed at the junction between the columella and the upper lip. Tip rotation should not be assessed using this parameter because this angle is influenced by the prominence of the caudal septum and/or anterior nasal spine. In other words, this angle can be prominent or retracted in the presence of a normal nasolabial angle. Alternatively, the columellar-lobular angle is a product of the normal divergence between the middle crura. By reducing the distance between the domes and this point of divergence one can create a more favorable tip contour although this does not directly alter the nasolabial angle.

Both the columellar-lobular and the columellar-labial angle contribute to nasal tip contour but do not objectively assess true tip rotation.

Physical examination focusing on both palpation and manual displacement of the tip, in both the caudad and cephalad directions, should be performed to aid in assessment of the integrity of the tip-supporting structures. The anatomy of the septum, and the lower and upper lateral cartilages should be examined because abnormalities in width, length, shape, and symmetry, as well as the degree of convexity/concavity help determine tip rotation and support. Additionally, both the thickness and the sebaceous character of the nasal skin should be considered. Thicker and more sebaceous skin typically results in less contractility such that tip modification maneuvers may be more readily camouflaged.

Animated views should be obtained to assess for hyperactivity of the depressor septi nasi muscles, which can cause a decrease in tip rotation through their attachments to the medial crura footplates and the anterior septum. Patients diagnosed with this finding typically have the characteristic triad of a shortened upper lip, a transverse crease in the midphiltral area, and a drooping nasal tip during animation or on smiling.

CLINICAL ANATOMY

Nasal tip rotation is determined by the interplay of the underlying cartilaginous structures and their connective tissue attachments. The following nine factors are the key elements that contribute to nasal tip support and determine its position:

1. Skin attachments to the underlying cartilaginous framework
2. Fibrous attachments between the upper and lower lateral cartilages
3. Abutment of the lower lateral cartilages against the piriform aperture
4. Suspensory ligament connecting the cephalic margins of the domes
5. Prominence of the caudal septum
6. Attachments between the medial crura and the caudal septum
7. Length of the upper lateral cartilages
8. Location of the anterior septal angle
9. Activity of the depressor septi nasi muscle

To modify tip rotation, the surgeon must evaluate each of the factors and surgically alter them as indicated.

Every effort should be made to minimize disruptions to the supportive elements of the nasal tip or, conversely, counter each disruptive maneuver with a support-

ive maneuver. Predictable, long-lasting results rely on adequate stabilization of the nasal base and strong structural support of the nasal tip. Iatrogenic loss of nasal tip support may manifest as loss of either tip projection and/or rotation. Studies by both Rich et al[18] and Petroff et al[19] found loss of tip projection occurred following rhinoplasty.

Historically, changes in tip projection and rotation relied on destructive surgical manipulation of the lower lateral crura. The dependence of these maneuvers on irreversible, destructive modification of the tip-supporting elements has been slowly abandoned for incremental, reversible, and nondestructive techniques such as tip suturing.

Despite these advances, even the most routine rhinoplasty maneuvers violate key tip-supporting structures. These include transfixion incisions, cephalic trim, or division of the lower lateral crura, resection of the dorsal or caudal septum, and division of the suspensory ligament.

Major and Minor Tip-Supporting Mechanisms

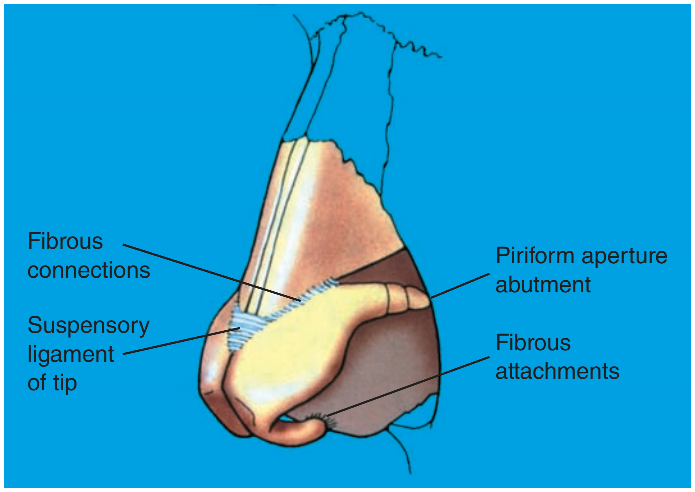
Major	Minor
Shape, size, and pliancy strength of lower lateral crura	Attachment of the paired domes, anterior nasal spine, and membranous septum
Attachment between septum and upper lateral cartilages	Attachments of the lateral crura to the piriform aperture
Attachment between septum and medial crus	
Anterocaudal septum	

Although some instability is a natural concomitant of rhinoplasty surgery, reinforcing maneuvers should be employed whenever possible to reestablish support of the tip support.

Skin

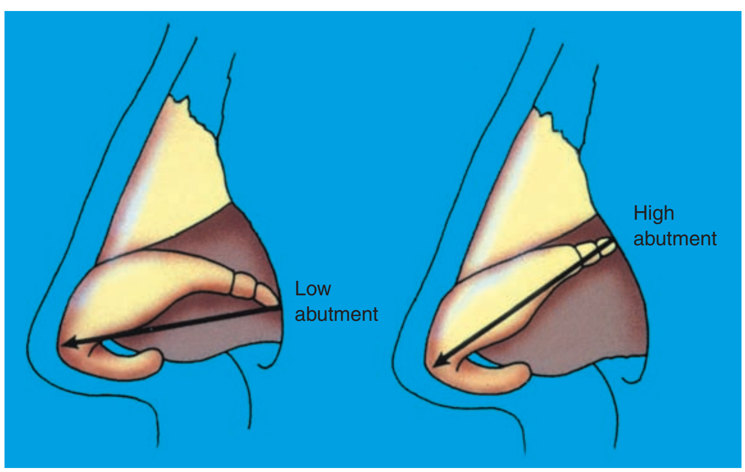
The nasal skin and underlying soft tissue are adherent to the lower lateral and upper lateral cartilages, thus resisting movement of the nasal tip. Dissection of the skin and soft tissues away from the underlying cartilages removes these attachments and allows the lower lateral cartilages to be repositioned.

Scroll Attachments



The cephalic margins of the lower lateral crura are joined to and overlap the caudal margins of the upper lateral cartilages by connective tissue fibers that assist in tip support. An incision placed between the upper and lower lateral cartilages (intercartilaginous) and extending to the cephalic margin of the medial crus will eliminate the support supplied by these fibers, so the lower lateral cartilages can be positioned independent of the upper lateral cartilages. Resection of the cephalic margins (cephalic trim) of the lateral crura and lower lateral crural turnover flaps will accomplish the same release of these attachments.

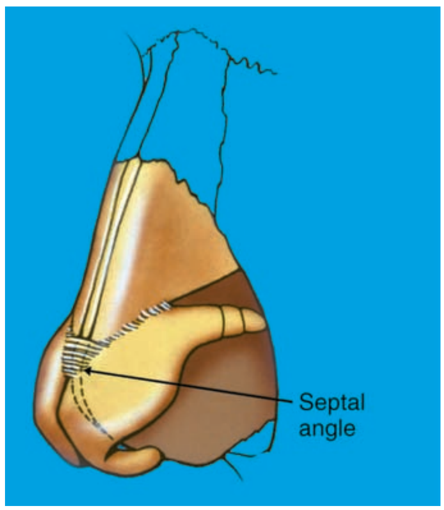
Abutment of the Lateral Crural Complexes With the Piriform Aperture



The stability of the lateral crural–accessory cartilage junction and the position of the abutment of the lateral crural complexes with the piriform aperture provide

varying degrees of support for the tip. If the stability is strong and the abutment is high on the piriform aperture, it may also resist upward rotation of the tip. In these cases it may be necessary to transect the lateral crural–accessory cartilage junction to improve mobilization of the lateral crural complex. When decreasing tip rotation, the attachments to the accessory cartilages may serve as a tether point that must be released to lengthen the lateral crura or to move the lower lateral cartilages caudally.

Suspensory Ligament of the Tip



The suspensory ligament of the tip is a ligamentous connection between the dermis of the skin and the cephalic margins of the lower lateral crura as they diverge from each other in the supratip area. This ligament also attaches to the anterior septal angle. It must usually be divided in nasal tip procedures to allow for mobilization of the lower lateral cartilages.

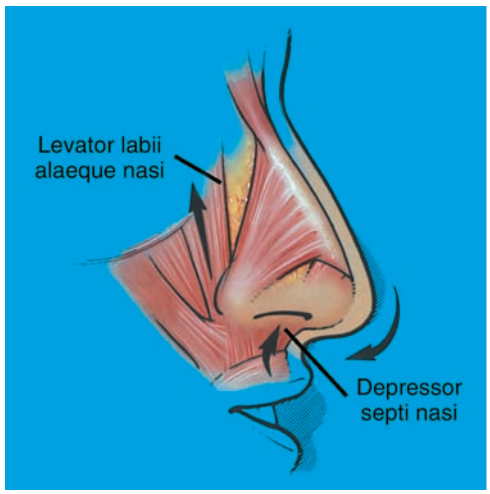
Caudal Septum

A prominent caudal septum may directly affect the columellar-labial angle. This angle may be modified by shaping the anterior and/or posterior parts of the caudal septum.

Anterior Septal Angle

The anterior septal angle influences tip rotation through its attachments with the suspensory ligament of the tip. This support can be eliminated by lowering the anterior septal angle or dividing the suspensory ligament. In the septal dependent tip, division of these supporting structures between the tip complex and the anterior septum can also lead to derotation and/or deprojection of the nasal tip if support is not reestablished.

Depressor Septi Nasi Muscles



Hyperactivity of the depressor septi nasi muscles in some patients may derotate the tip during animation, particularly when they are smiling, giving the appearance of a plunging tip. This occurs because these muscles are attached to the feet of the medial crura as well as the anterior septum. Patients will typically present with a shortened upper lip, a transverse crease in the midphiltral area, and a descending nasal tip when smiling. This dynamic derotational force can be eliminated through transnasal release of these muscles off of the caudal septum and the medial crura or transoral dissection and transposition.

The fibrous attachments of the lower lateral cartilages to the skin, upper lateral cartilages, piriform aperture, and caudal septum provide support and determine the position of the tip. Surgical maneuvers such as transfixion incisions, cephalic trim, intercartilaginous incisions, and division of the lower lateral cartilages will disrupt these supporting structures and allow rotational changes of the lower lateral cartilages.

OPERATIVE TECHNIQUES

Control of tip position and the nasolabial angle through rotation or derotation of the tip can be achieved in most cases with the use of a graduated approach that relies on sequential, controlled maneuvers, minimizes cartilage resecting techniques, and reserves visible cartilage graft techniques as a last resort. This is summarized in the following algorithm:

1. The degree of tip rotation or derotation required is based on the nasolabial angle.
2. Alteration of tip rotation is best performed using an open approach which affords full exposure of the cartilaginous structures.
3. Division of the suspensory ligament and dissection of the medial crura from the caudal septum will free the lower lateral cartilages and allow rotation of the tip complex. Additionally, wide skin undermining will allow tip rotation. These maneuvers release the restrictive, tethering forces from the ligamentous and fibroelastic attachments between lower lateral cartilages and the septum and upper lateral cartilages.
4. Dorsal height is established after which septal cartilage is harvested if it is needed for grafting.
5. The anterior septal angle is modified along with any caudal septal resection, if indicated.
6. The lower lateral cartilages are separated from the upper lateral cartilages at the scroll area. If tip definition is desired, cephalic trim or lower lateral cartilage turnover flaps may be required.
7. Tip support is then enhanced by placement of a columellar strut graft followed by medial crural–columellar strut sutures.
8. Tip suturing techniques are used to alter tip rotation.
9. Medial crural septal sutures secure the middle crura to the caudal septum.
10. If shortening of the lower lateral crura is indicated, this may be achieved by transection and overlap. If repositioning of the lower lateral crura is indicated, this may be achieved by division at the junction with the accessory cartilages and repositioning along the piriform aperture.
11. Septal extension grafts are placed if significant alteration of tip rotation is required.
12. Visible grafts including placement of infratip grafts may be required to further alter tip rotation.

Increasing Tip Rotation

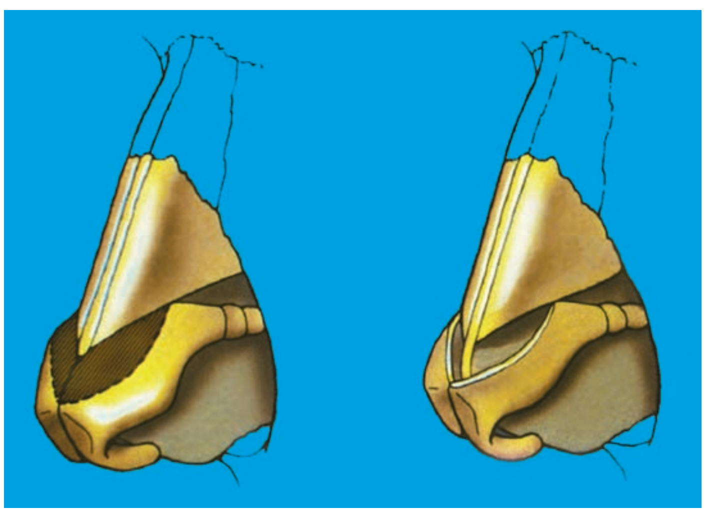
Tip rotation may be increased through several techniques alone or in conjunction. These techniques enable mobilization and upward rotation of the tip, increasing the nasolabial angle and decreasing the distance between the radix and the tip-defining points. These changes represent shortening of the nose.

Upward rotation of the tip increases the nasolabial angle and decreases the distance between the nasofrontal angle and the tip-defining points. These changes represent shortening of the nose.

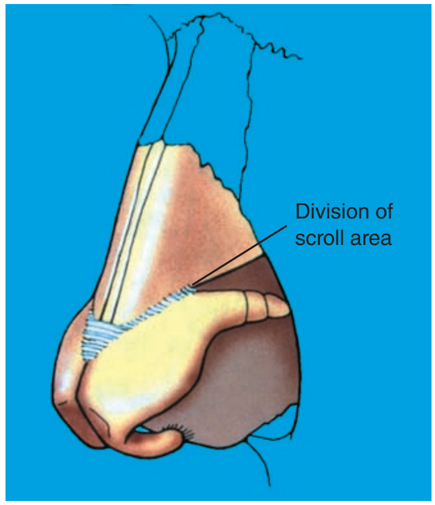
Skin Undermining

Given its supportive attachments to the underlying nasal framework, the skin resists upward rotation of the tip. Therefore, undermining of the skin over the nasal tip and lower dorsum eliminates this resistance and thus allows rotation of the cartilages. This is typically carried out in most rhinoplasty procedures, whether through the open or closed approach.

Division of Scroll Area/Cephalic Trim



The restriction of movement provided by the fibrous attachments between the lateral crura and upper lateral cartilages may be eliminated by an intercartilaginous incision, division at the scroll area, or by resection of the cephalic margin of the lateral crura.



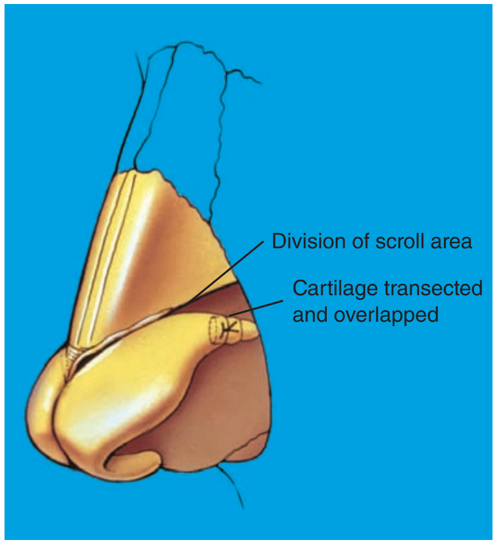
It is also essential to divide the upper lateral scroll area entirely to prevent further abutment and ensure adequate space for rotation. The lateral crura will then not only lack restricting forces but will also have the space required to rotate upward.

Tip Suturing

For the long nose which requires shortening and cephalic rotation, the lower lateral cartilages can be sutured directly to the caudal septum. The dorsal aspect of the caudal septum is degloved and the cephalic borders of the medial crura are sutured to the septum thus rotating the lower lateral cartilages cephalically.

When performed in conjunction with maneuvers to correct and/or shorten the columellar-labial angle, the caudal septum should be resected from the anterior nasal spine up to the level where the middle crura diverge. This allows for shortening and correction of the columellar-labial angle with maximal control of tip rotation and projection secondary to preservation of an extension of the anterior septum.

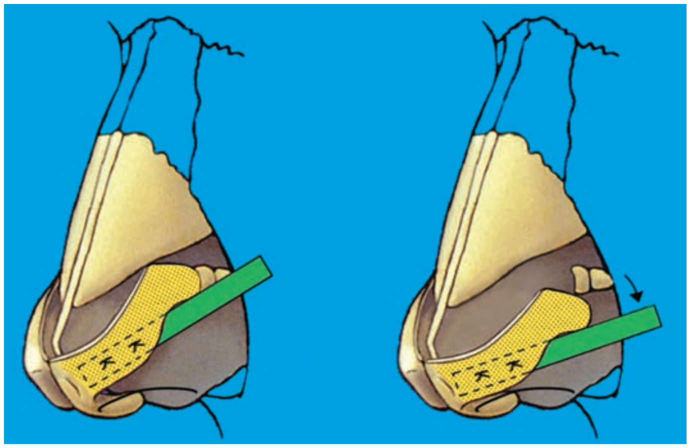
Transection of the Lateral Crural Complex



In some patients, the lateral crural complexes may be oriented cephalically, thus resulting in a high abutment on the piriform aperture. This results in increased resistance to upward movement of the tip. This resistance correlates with the height of the junction with the piriform aperture: the higher the junction, the more resistance there is to rotation. This resistance can be eliminated by undermining the vestibular skin laterally and then transecting the lateral crural complex at or slightly medial to its junction with the accessory cartilages.

The transected ends can then be overlapped and sutured, shortening the lateral crura and producing upward rotation of the tip. If necessary, the lateral crura may be repositioned caudally along the piriform aperture; this may require the placement of lateral crural strut grafts. A columellar strut graft may be needed to maintain the rotation and avoid backward movement of the medial crura.

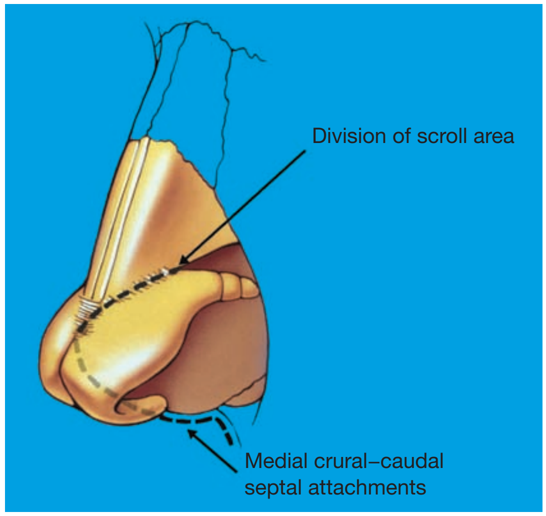
Lateral Crural Strut Graft



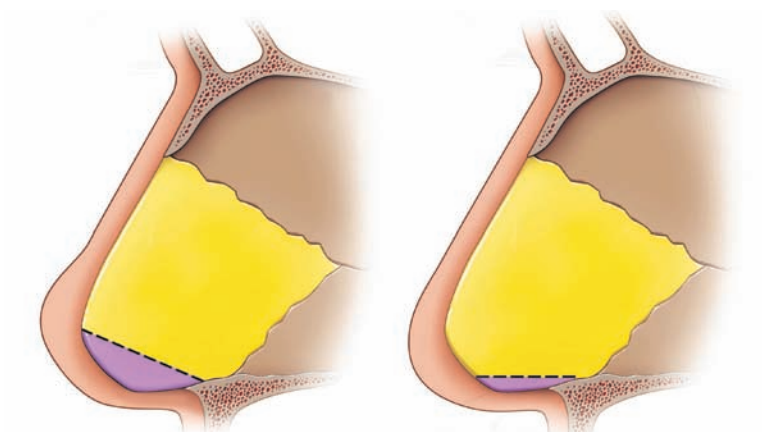
The lateral crural strut graft can be used to alter tip rotation by adjusting the length and strength of the lateral crura. The modified lateral crural strut graft is placed caudal to the lateral crus along the alar rims and can be used to increase tip rotation while preventing alar retraction, notching and collapse. The pocket position can be altered to effect the angulation of the lateral crural strut graft and thus increase or decrease tip rotation accordingly.

Caudal Septal Resection

The tip may still not rotate with the use of the aforementioned techniques if the caudal end of the septum interferes with upward movement of the medial crura. In most noses, there is a space between the anterior portion of the caudal septum and the medial crura (membranous septum) that is filled with loose connective tissue. This tissue offers little resistance to upward movement of the anterior medial crura, and when the other forces resisting upward rotation are eliminated, the tip can move in that direction until the medial crura abut the anterior caudal septum. For this reason it may be unnecessary to resect the caudal septum if only a small amount of upward rotation is desired.



When significant rotation is desired, the attachments of the medial crura to the caudal septum may be interrupted to adequately release the tip. This enables anterior movement of the medial crura. Although this may be performed using a transfixion incision, resection of the caudal septum may be indicated in some patients with excessive cartilaginous length in this area.



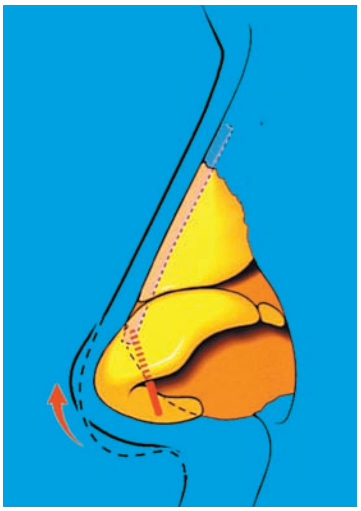
Caudal septal resection removes the excess septal cartilage and the attachments to the medial crura simultaneously. It should always be individualized and conservative because even minor oblique resection of the distal septum may cause excessive rotation and loss of tip projection. If the columellar-labial angle is normal, resection should involve only the anterior portion of the caudal septum.

If the columellar-labial angle is displaced downward and outward, as is often seen in patients with class II skeletofacial deformities who have short upper lips, more cartilage is resected from the posterior portion of the caudal septum and the nasal spine area. Any resection of caudal septum is usually accompanied by a corresponding resection of a portion of the membranous septum.

Adjustment of the Anterior Septal Angle

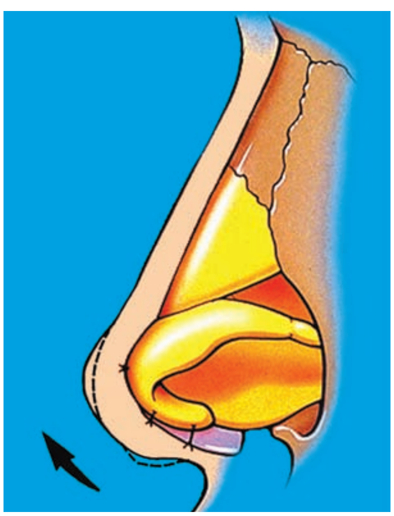
A high anterior septal angle will resist upward rotation if the suspensory ligament of the tip connecting the domes is intact. This resistance can be eliminated by lowering the anterior septal angle and/or interrupting the suspensory ligament

Medial Crural Septal Sutures



After the dorsal and caudal septum have been set, medial crural sutures can be used to secure the medial crura to the caudal septum to alter tip projection and rotation. If the medial crura are fixed to a more anterior position on the caudal septum, the tip will rotate in a cephalad direction and tip projection will increase. Alternatively, if the medial crura are fixed to a more posterior position on the caudal septum, the tip will derotate and deproject.

Columellar Strut Graft

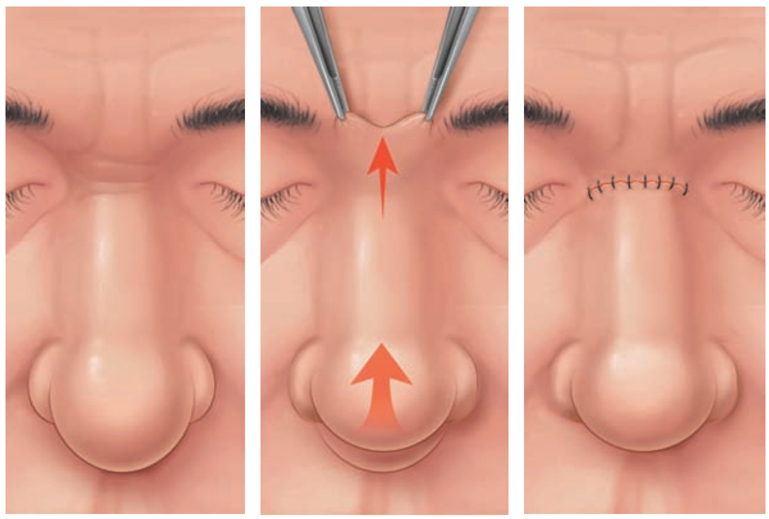


A columellar strut graft is an excellent way to maintain and, in some cases, increase rotation of the tip after interruption of the restrictive attachments and the creation of sufficient space for upward movement of the tip. Septal cartilage is the best source for this graft, which is placed in a pocket between the medial crura, 2 to 3 mm anterior to the anterior nasal spine. The soft tissue between the end of the columellar strut graft and the anterior nasal spine prevents the strut from moving back and forth over the spine during animation. The strut should be sutured to the medial crura for stabilization.

Shortening of the Upper Lateral Cartilages

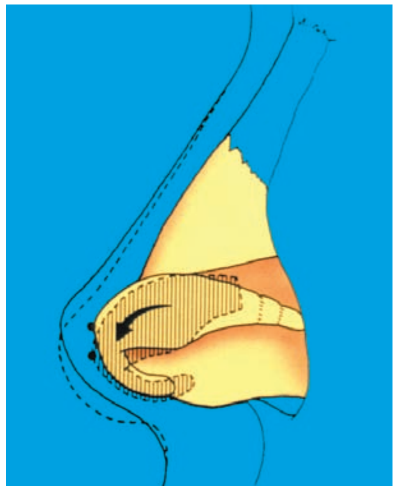
Resection of the upper lateral cartilages results in an upward rotation of the nasal tip. This maneuver can have disastrous consequences if not employed with caution, including the reduction of airflow secondary to internal nasal vault collapse and sidewall hollowing.

Excision of Radix Skin



In selected older patients with redundant skin over the radix, resection of this excess tissue (placing the scar along a transverse crease) may be a useful adjunct to the techniques described previously.

Decreasing Tip Rotation



Patients with increased rotation of the nasal tip have obtuse nasolabial angles and a decreased distance between the nasofrontal angle and the tip-defining points. This combination leads to a shortened nose. The treatment for this deformity is to rotate the lower lateral cartilages downward to translate the tip-defining points into a more caudal and anterior position. If the medial crural attachments to the caudal septum are released appropriately, the feet of the medial crura will also rotate in a posterior and cephalic direction. This rotation of the lower lateral cartilages results in a more acute nasolabial angle and an increased distance between the nasofrontal angle and tip-defining points. These changes represent lengthening of the nose.

Downward rotation of the nasal tip may be performed using the following: undermining of the nasal skin, release of the lower lateral cartilages from the upper lateral cartilages and nasal septum, resection of the posterior caudal septum, rotation and stabilization of the lower lateral cartilages in a posterior direction, and tip-suturing techniques.

Downward rotation of the tip decreases the nasolabial angle and increases the distance between the nasofrontal angle and the tip-defining points. These changes represent lengthening of the nose.

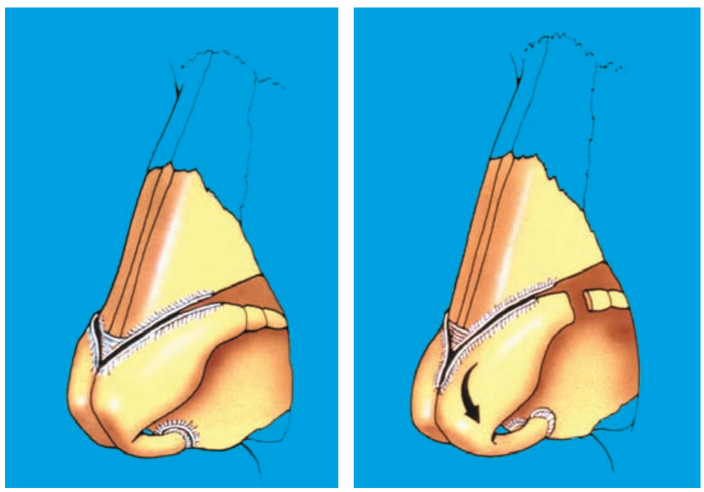
When disrupting the tip-supporting structures to allow tip derotation, it is critical to reestablish tip support to avoid a concomitant loss of tip projection.

When disrupting the tip-supporting structures to allow tip derotation, it is critical to reestablish tip support to avoid a concomitant loss of tip projection.

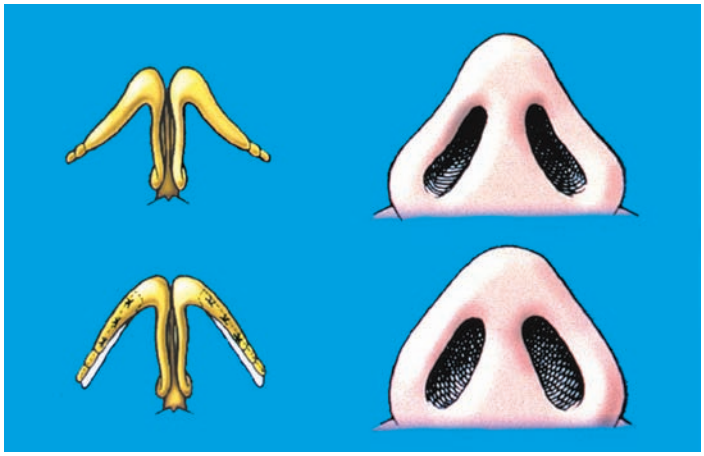
Skin Undermining

Wide undermining of the nasal skin is also necessary to derotate the tip. This maneuver interrupts the attachments between the skin and the lower lateral cartilages, decreasing the resistance to mobilization of the tip. Undermining is also performed to allow redraping of the skin over the caudally rotated framework.

Release of the Lower Lateral Cartilages

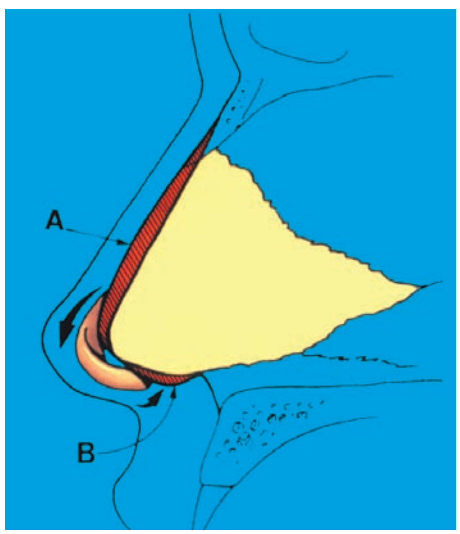


Downward rotation of the lower lateral cartilages is feasible only if they are freed from their attachments to the upper lateral cartilages, septum, and piriform aperture. This is accomplished with an intercartilaginous incision, division at the scroll area, or by resection of the cephalic margin of the lateral crura. The attachments of the suspensory ligament between the cephalic margins of the lateral crura and the anterior septal angle are also divided. These techniques free the lower lateral cartilages from the upper lateral cartilages and septum. The extended complete transfixion incision separates the attachments of the medial crura to the caudal septum. If the lateral crura adhere tightly to the piriform aperture and this limits rotation, a vertical incision through the lateral portion of the lateral crura (at the junction with the accessory cartilages) may be performed to overcome this resistance. With the attachments eliminated, the lower lateral cartilages are free to be rotated downward.



When transecting the lateral crura to derotate the tip, it is usually necessary to lengthen the lateral crura and also add additional support in the form of lateral crural strut grafts to prevent loss of tip support and/or alar rim collapse.

Septal Resection



As the lower lateral cartilages rotate posteriorly, the dorsal septum becomes more prominent and may require reduction to prevent supratip fullness. Additionally, to allow the feet of the medial crura to move posteriorly and slightly more superiorly, the attachments of the medial crura to the caudal septum may need to be released or a portion of the posterior caudal septum may need to be resected.

With the dorsal septum lowered and the posterior caudal septum resected, the lower lateral cartilages are rotated into their final position. This rotation retracts the columellar-labial angle in a superior and posterior direction and reduces the nasolabial angle, which results in the nasal base lying in a more horizontal plane. If tip projection is decreased significantly, an outward bowing of the alar rims may occur that may necessitate alar base surgery. If bowing of the columella occurs, this is corrected by membranous septum resection and medial crural septal sutures to pull the columella cephalad.

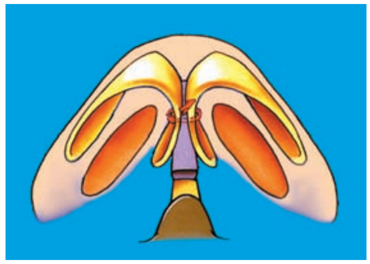
Maintaining Derotation of the Tip

The derotated tip complex requires stabilization in its new position. This is important because the inferiorly rotated tip complex must be adequately fixated to prevent relapse and therefore postoperative shortening of the nose with an increase of the nasolabial angle. Additionally, disruption of the tip-supporting structures without reestablishing adequate support will lead to loss of tip projection. The most commonly used techniques are a columellar strut graft and variations of septal extension grafts (including extended spreader grafts).

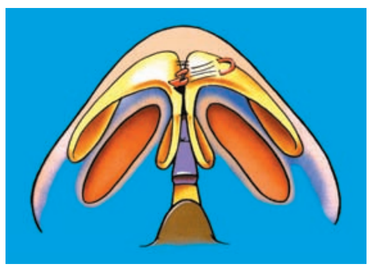
A columellar strut graft will help to reestablish tip support and maintain tip projection. After disruption of the soft tissue and ligamentous attachments between both lower lateral cartilages and also their attachments to the septum, a columellar strut graft with medial crural–columellar strut sutures will unify the tip complex while preventing posterior displacement.

Along the same lines, the attachments between the tip complex and the anterior septum are one of the major tip-supporting mechanisms and disruption without reestablishment will lead to deprojection of the tip and loss of control of tip position. Septal extension grafts fix the tip complex directly to the anterior septum allowing accurate control of tip position and long-term support of the tip complex. Septal extension grafts are discussed in detail in Chapter 23.

Tip Sutures

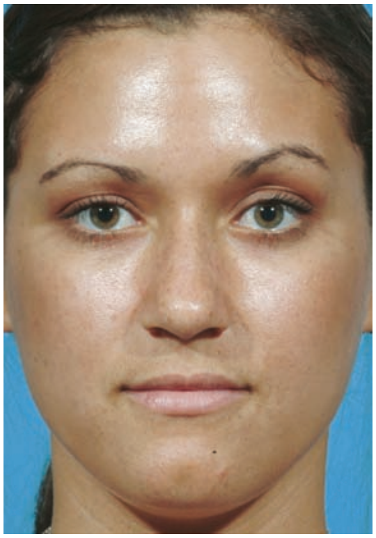
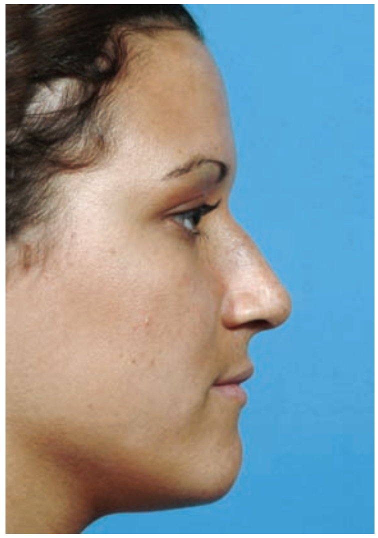
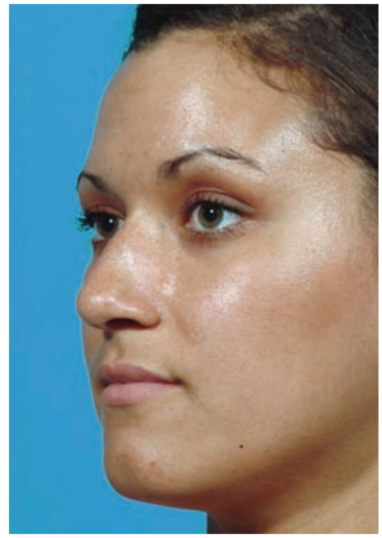


Tip-suturing techniques are commonly used and can effect tip rotation. Most commonly medial crural–columellar strut sutures are used to fixate a columellar strut graft to the medial crura.

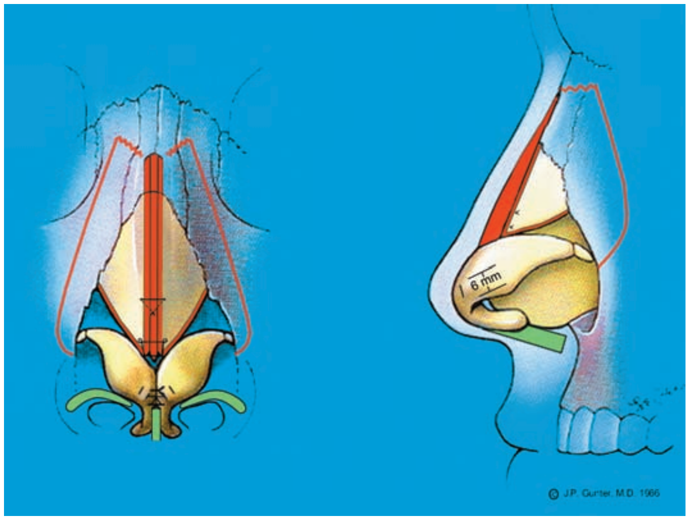


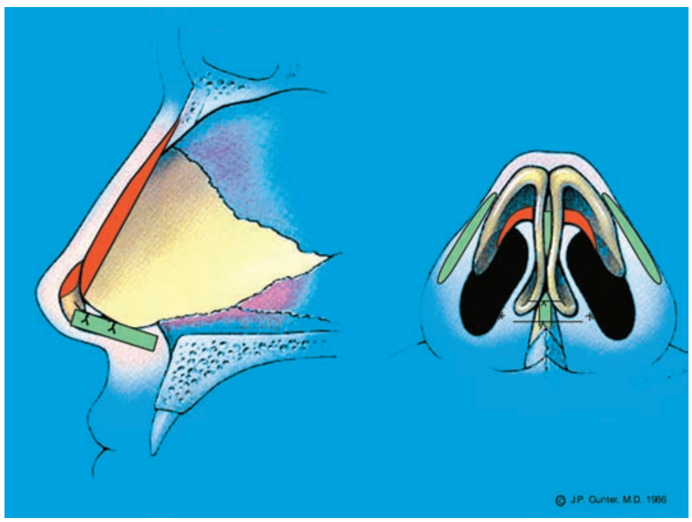
Transdomal sutures involve placement of a horizontal mattress suture between the domes of the middle crura of the lower lateral cartilages. If placement of the sutures is closure to the tip, this will help shorten the middle crura and infratip lobule resulting in a decrease in the columellar-lobule angle and subtle derotation of the tip.

CASE ANALYSES


This 24-year-old woman requested correction of her dorsal hump and tip refinement. On frontal view her ill-defined dorsal aesthetic lines and a large, underrotated tip were evident. The lateral view showed a dorsal hump and supratip fullness, confirming inadequate tip rotation. The basal view revealed a mildly bulbous tip.



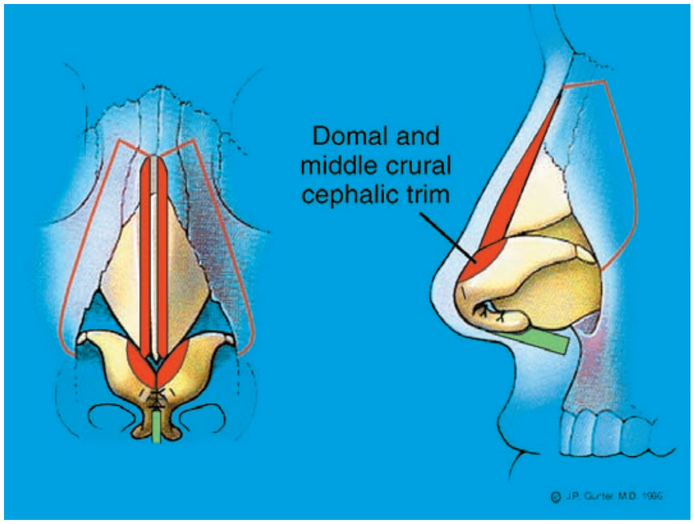


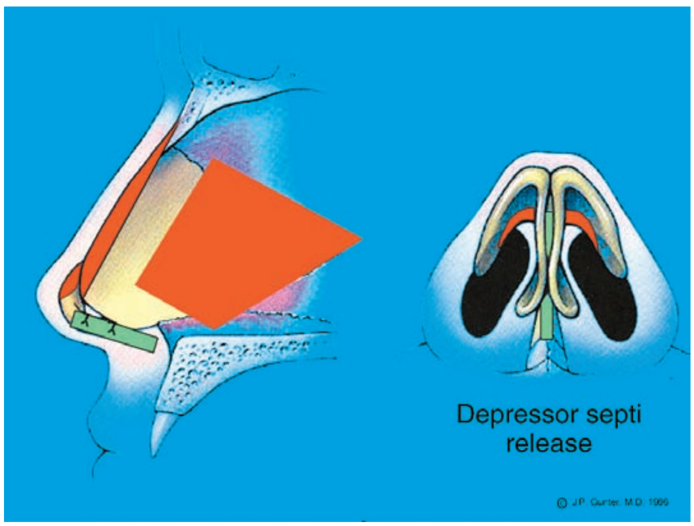
The operative goals included the following:

- Perform open rhinoplasty.
- Perform wide undermining to release the lower lateral cartilages from the overlying skin attachments.
- Reduce the dorsal hump (3 mm) in component fashion.
- Place upper lateral cartilage tension-spanning sutures.
- Perform cephalic trim, leaving a 6 mm alar rim strip for both tip refinement and division of the scroll area.
- Place a columellar strut graft and medial crural–columellar strut sutures to unify the tip.
- Use interdomal and transdomal sutures to correct the boxy tip and shape the infratip lobule.
- Craft bilateral alar contour grafts.
- Perform percutaneous perforated lateral nasal osteotomies.
- Place medial crural footplate reapproximation sutures.

Note the improvement in her lateral profile, with a smooth, straight dorsum and supratip break. There is increased tip rotation with a more balanced infratip lobule and increased columellar-lobular angle.

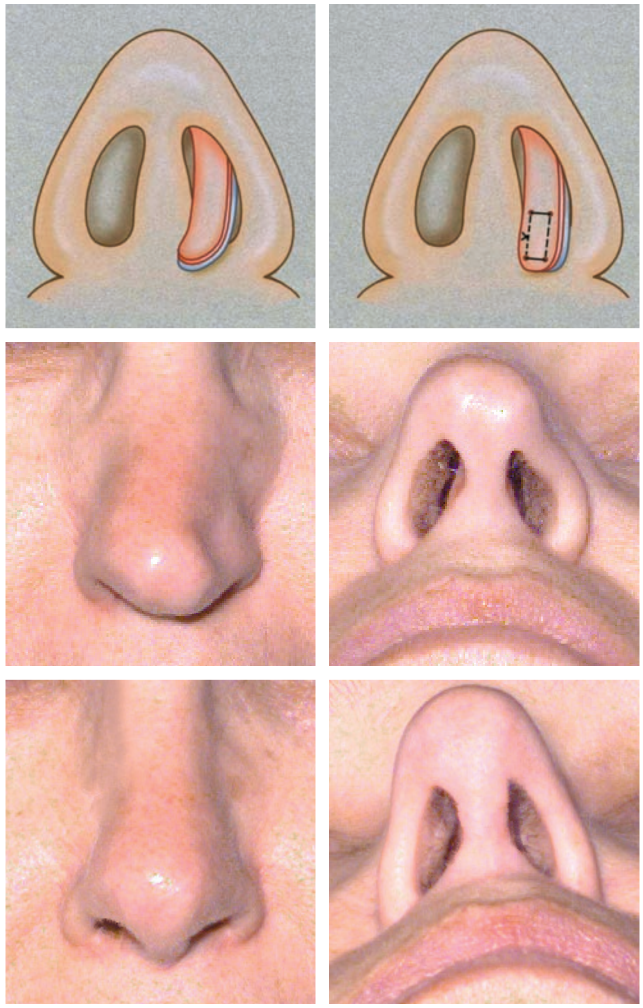
This 24-year-old woman presented for correction of her boxy tip. She had asymmetrical fullness of the supratip as a result of the malpositioned tip. The left lower lateral cartilage was more obliquely rotated than the right, and she had excess lateral alar convexity with alar notching.





The operative goals included the following:

- Perform an open rhinoplasty.
- Perform wide undermining to release the lower lateral cartilages from the overlying skin attachments.
- Reduce the dorsal hump (2 mm) in component fashion.
- Reconstruct the septum and harvest septal cartilage.
- Perform cephalic trim, leaving a 6 mm alar rim strip for both tip refinement and division of the scroll area.
- Place columellar strut graft and medial crural–columellar strut sutures to unify the tip complex.
- Use interdomal and transdomal sutures to correct the boxy tip and shape the infratip lobule.
- Craft bilateral alar contour grafts.
- Perform percutaneous perforated lateral nasal osteotomies.
- Perform transoral dissection and transposition of the depressor septi nasi muscle.



Note the improvement of the dorsal aesthetic lines and refinement of the boxy nasal tip. The lateral profile shows a smooth, straight dorsum. There is a subtle decrease in tip rotation, with a decrease in the columellar-labial angle and an increase in the columellar-lobular angle.

KEY POINTS

- Nasal tip rotation should be analyzed by assessing the nasolabial angle, which should be 95 to 110 degrees in white women and 90 to 95 degrees in white men.
- Both the columellar-lobular and the columellar-labial angle contribute to nasal tip contour but do not objectively assess true tip rotation.
- Although some instability is necessitated by the very nature of rhinoplasty surgery, reinforcing maneuvers should be employed whenever possible to re-establish support of the tip support.
- The fibrous attachments of the lower lateral cartilages to the skin, upper lateral cartilages, piriform aperture, and caudal septum provide support and determine the position of the tip. Surgical maneuvers such as transfixion incisions, cephalic trim, intercartilaginous incisions, and division of the lower lateral cartilages will disrupt these supporting structures and allow rotational changes of the lower lateral cartilages.
- Upward rotation of the tip increases the nasolabial angle and decreases the distance between the nasofrontal angle and the tip-defining points. These changes represent shortening of the nose.
- Downward rotation of the tip decreases the nasolabial angle and increases the distance between the nasofrontal angle and the tip-defining points. These changes represent lengthening of the nose.
- When disrupting the tip-supporting structures to allow tip derotation, it is critical to reestablish tip support to avoid a concomitant loss of tip projection.

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26

Importance of the Alar-Columellar Relationship

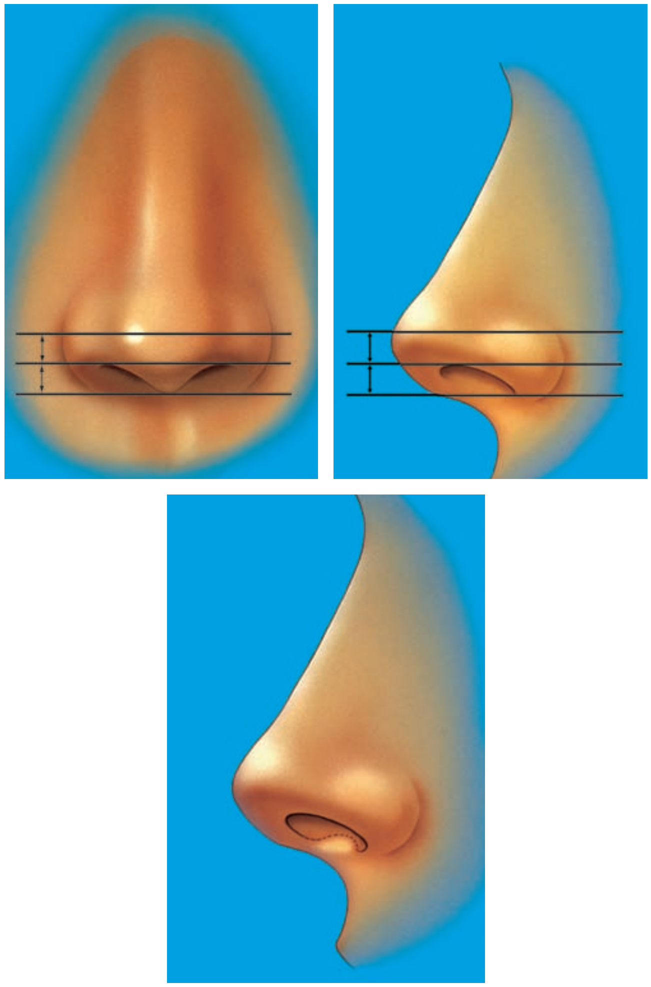
Jack P. Gunter ▪ Rod J. Rohrich ▪ T. Jonathan Kurkjian ▪ Jamil Ahmad

The alar-columellar relationship (ACR) has received little attention in the rhinoplasty literature. Sheen and Sheen[1] described the ACR as exhibiting 2 to 3 mm of columellar show on the lateral view. McKinney and Stalnecker[2] stated that the indications to change the ACR were dependent on aesthetic judgment. Experienced surgeons may be able to use their aesthetic judgment to make these decisions[1-4]; however, we think a more consistent and predictable method of planning is preferable.

In addition, the terminology describing the ACR is often confusing and ill-defined, such as the term *hanging columella.* How much columella has to be exposed before it is considered hanging? Is it possible to have both a hanging ala and a retracted columella? What determines when the ala and the columella are in the correct position and in harmony with each other? To answer these questions, several hundred patient photographs were reviewed by the senior authors to establish what constitutes a normal ACR and to classify different types of alar-columellar discrepancies.

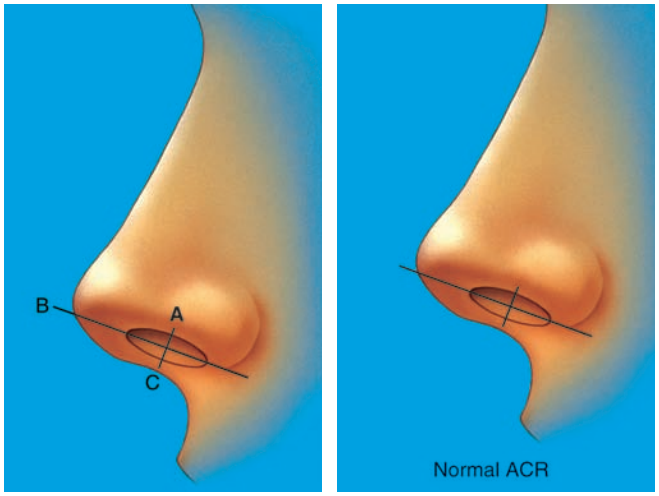
ALAR-COLUMELLAR RELATIONSHIPS

Although the ACR is seen more directly on the lateral view, it is important to study it from the frontal view as well. On the frontal view, an aesthetically pleasing ACR will be demonstrated by lines drawn along the alar rims connecting at the columellar-lobular angle that resemble the wings of a seagull in gentle flight, as described by Sheen and Sheen.[1]



In the ideal nose, the vertical distance between the columellar-lobular angle and the tip-defining points can be divided in half by a horizontal line adjacent to the highest point of the alar rims. When this is not the case, an alar-columellar discrepancy is usually present.

The same relationship is also seen on the lateral view. However, the most valuable observation on the lateral view is that in aesthetically pleasing noses the outline of the nostril simulates an oval. The alar rim forms the upper half of the oval and the lower half is formed by the columellar rim at the junction of the external skin with the vestibular skin. This oval is occasionally interrupted by flaring of the feet of the medial crura, but this does not change the visual exposure of the columella and should be disregarded when studying the relationship. A line drawn through the most anterior and posterior points of the oval represents the long axis and divides the oval into upper and lower parts.

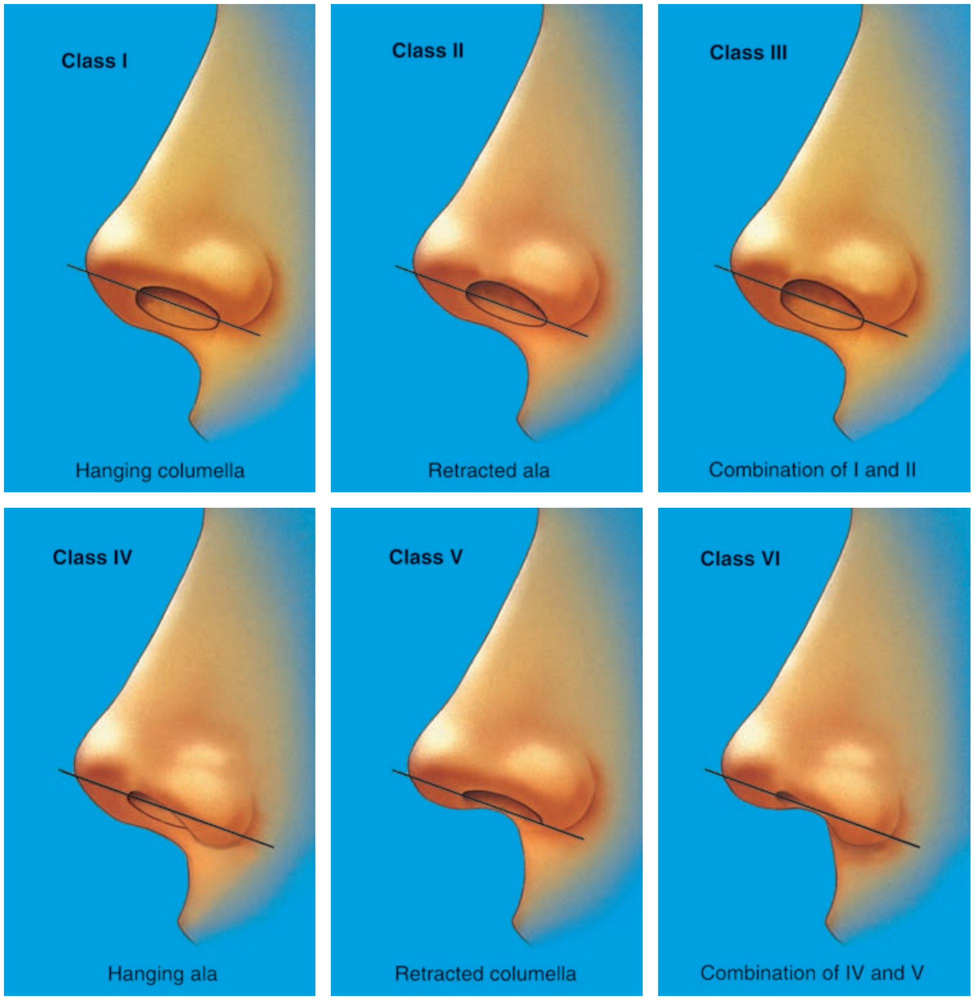


In a normal ACR, the distance from the columellar rim or the alar rim to the long axis of the nostril should be 1 to 2 mm.[5] It must be noted, however, that the total distance from the alar rim to the columellar edge should be no greater than 3 mm. In other words, if *AB* = 2 mm, then *BC* should be no larger than 1 mm. Likewise, the inverse relationship is also true: if *BC* = 2 mm, then *AB* should be no greater than 1 mm. Although this is ultimately subjective, our review of patient photographs confirms that these measurements seem to provide optimal aesthetics on both the frontal and lateral views. By using the distance from the long axis to the alar rims superiorly *(AB)* and to the columellar edge inferiorly *(BC),* we have categorized ACRs into six classes. Classes I to III relate to increased columellar show, whereas classes IV to VI describe decreased columellar show.

The total distance from the alar rim to the columellar edge should be no greater than 3 mm to provide optimal aesthetics on both the frontal and lateral views.

A line drawn through the most anterior and posterior portions of the oval-shaped nostril should divide the nostril into upper and lower segments that are evaluated separately to determine treatment.

CLASSIFICATION AND TREATMENT



Class I to III Relationships: Increased Columellar Show

Class I is a true hanging columella in which the distance between the long axis of the nostril and the columellar edge is greater than 2 mm and the distance from the long axis to the superior nostril rim is 1 to 2 mm.

Correction of a hanging columella involves resection and reapproximation of the membranous septum with or without the caudal septal edge to reposition the columella superiorly.[6]

If the medial crura have an increased width that contributes to the amount of columellar exposure, resection of the caudal border and overlying vestibular skin with reapproximation of the skin edges repositions the columellar border superiorly.[7,8]

In some patients the anterior portion of the medial crura (intermediate crura) is vertically oriented. Resection of a portion of the intermediate crura and reapproximation will raise the anterior columella superiorly, thereby decreasing the amount of columellar show. More than one of the preceding procedures may be indicated in the same patient, depending on the physical findings.

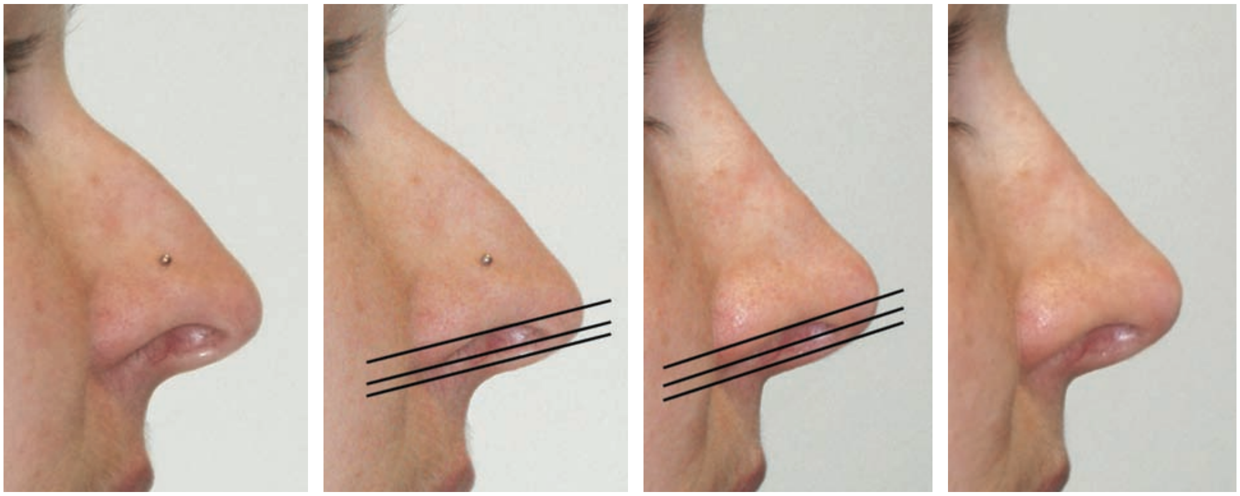
Columellar show resulting from a true hanging columella is treated by resection of the membranous septum with or without the caudal septum, resecting the caudal margin of the medial crura, or resecting a vertically oriented segment of the medial crura (intermediate crura).

Class II is a retracted ala characterized by an alar rim to nostril long axis distance of greater than 2 mm and a long axis to the columellar edge measurement of 1 to 2 mm. In this situation the surgeon must be careful not to misdiagnose the retracted ala as a hanging columella. Obviously, the treatments are different. Procedures to correct the retracted ala focus on lowering the alar rim by the use of composite or cartilage grafts.[9-11]

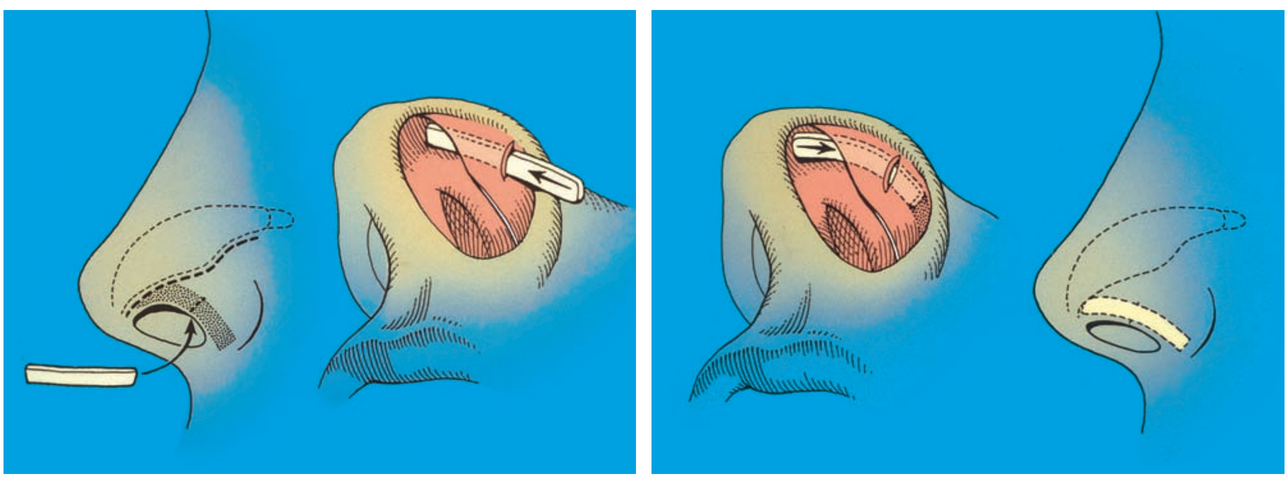
The retracted alar rim should not be misdiagnosed as a hanging columella, because treatment varies significantly.

The retracted ala is treated by interposition of a composite graft into a defect created in the nasal vestibule above the alar rim, insertion of an alar contour graft into an undermined pocket above and parallel to the nostril rim, or caudal repositioning of the lateral crura.

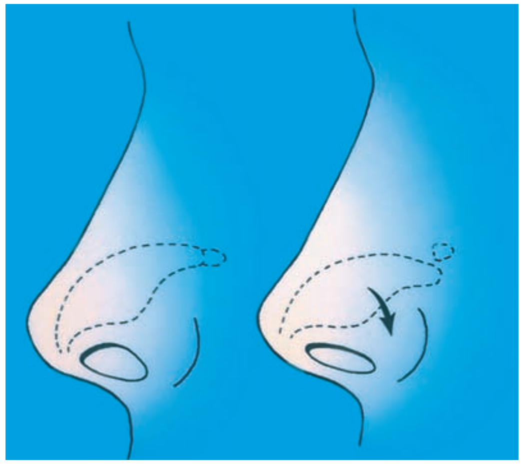
With composite grafts, an incision is made in the vestibular skin parallel to and above the alar rim. The vestibular skin is undermined to allow it to be retracted caudally so the alar rim can be lowered. A septal or conchal cartilage composite graft is trimmed in a fusiform shape and sutured in the defect. A composite graft slightly larger than needed is used to compensate for secondary contracture of the graft, which can be unpredictable.



In this situation, our preferred approach is to use an alar contour graft to lower the alar rim.[5] A pocket is undermined through anterior and posterior vertical incisions just above the nostril rim on the vestibular rim side. If an infracartilaginous incision has been used for exposure, then an anterior vertical incision is unnecessary.



A straight strut of autologous cartilage (3 by 12 to 15 mm) placed in the undermined tunnel will force the caudal rim inferiorly, decreasing the columellar show.



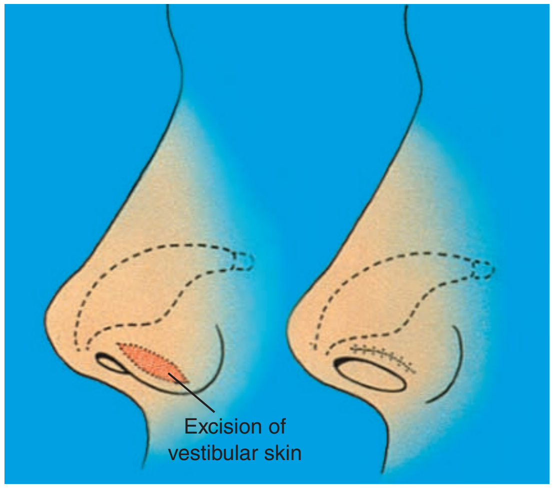
When alar retraction is mild and is not associated with a tissue deficiency, the lateral crura can be detached from the accessory cartilages and repositioned inferiorly. This moves the alar rim inferiorly.[12]

Treatment of a retracted ala requires a composite graft of septal cartilage and mucosa, a composite graft of conchal cartilages and skin, or an alar contour graft placed in an undermined pocket parallel to the nostril rim. For mild retraction, the lateral crus can be repositioned more caudally.

Class III is a combination of classes I and II. This combined deformity, which has characteristics of a hanging columella and retracted ala, requires the use of the procedures outlined above for each individual classification.

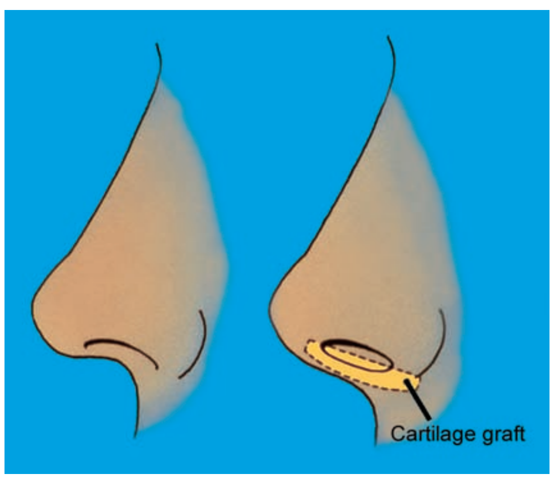
Class IV to VI Relationships: Decreased Columellar Show

Class IV is a hanging ala. The hanging ala results in decreased columellar show as a result of narrowing of the distance from the alar rim to the long axis of the nostril. Various methods of treatment have been described including direct excision of the ala.[13] In individuals with thin skin, careful trimming of the caudal border of the lateral crura without mucosa resection will elevate the alar rim.[2,14,15]

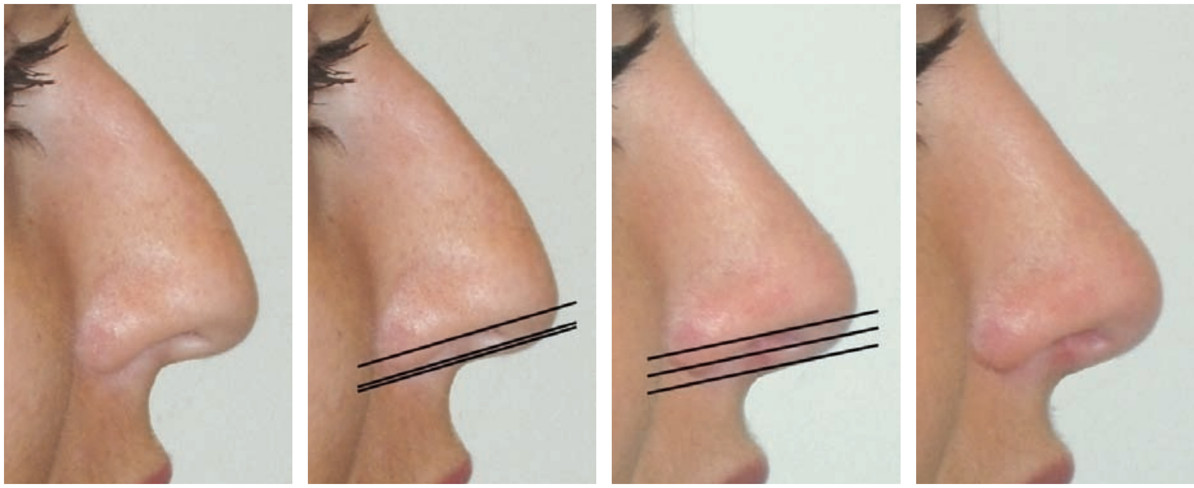


A horizontal ellipse of vestibular skin no more than 3 mm in width will raise the hanging ala to 2 mm without distorting the rim. The width of the resected ellipse should be slightly more than the desired amount of correction but should not exceed 3 mm. An abnormal rolled-in appearance of the alar rim may result if too much skin is resected.

The hanging ala is treated by excision of an ellipse of vestibular skin above the most hanging part of the ala, followed by direct closure.



Class V is a retracted columella characterized by a decreased distance between the columella and the nostril axis. The columella can be lowered by placing a carefully contoured columellar strut graft in a pocket between the medial crura with the caudal border of the graft extending inferior to the caudal margins of the medial crura.[16-18] The strut is carved so the widest portion is positioned at the area of greatest retraction. This will return the ACR to normal.



In addition, the strut may also be designed to alter the columellar-labial angle if indicated.[19]

The retracted columella is treated with a columellar strut graft to push the columellar skin in a downward direction.

Class VI is a combination of classes IV and V. This rare deformity is corrected by a combination of the treatments described for each individual classification.

CONCLUSION

The classification system described here enables the surgeon to more accurately diagnose alar-columellar discrepancies. The classification system also guides the surgeon in selecting the appropriate surgical procedure to correct the problem. Attention to alar-columellar discrepancies greatly improves the final aesthetic outcome and should be approached with the same meticulous attention to detail as in other rhinoplasty procedures.

KEY POINTS

- The total distance from the alar rim to the columellar edge should be no greater than 3 mm to provide optimal aesthetics on both the frontal and lateral views.
- The alar-columellar relationships are defined by a line through the long axis of the nostril and measurements to the alar rim superiorly and the columellar edge inferiorly.
- Columellar show resulting from a true hanging columella is treated by resection of the membranous septum with or without the caudal septum, resecting

the caudal margin of the medial crura, or resecting a vertically oriented segment of the medial crura (intermediate crura).

- The hanging columella is treated based on the anatomic abnormalities present with resection of the membranous septum with or without the caudal septum, resection of the caudal margin of the medial crura, or resection of the vertical portion of the medial crura.
- The retracted alar rim should not be misdiagnosed as a hanging columella, because treatment varies significantly.
- Treatment of a retracted ala requires a composite graft of septal cartilage and mucosa, a composite graft of conchal cartilages and skin, or an alar contour graft placed in an undermined pocket parallel to the nostril rim. For mild retraction the lateral crus can be repositioned more caudally.
- The hanging ala is treated by excision of an ellipse of vestibular skin above the most hanging part of the ala, followed by direct closure.
- The retracted columella is treated with a columellar strut graft to push the columellar skin in a downward direction.

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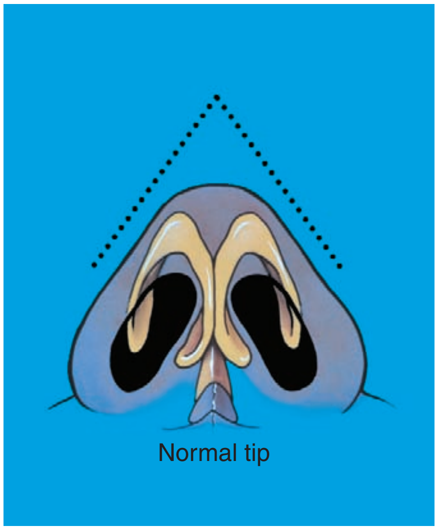
PART FIVE

Alar Rims



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Correction and Prevention of Alar Rim Deformities: Alar Contour Grafts

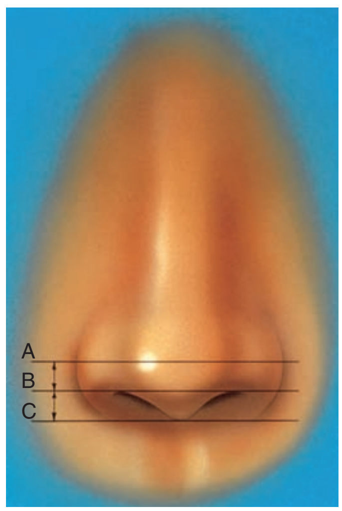
Rod J. Rohrich ▪ Jason Roostaeian ▪ Jamil Ahmad

Deformities of the alar rim are frequently encountered in both primary and secondary rhinoplasty. Often caused by congenital malpositioned lateral crura or from overaggressive surgical manipulation of the lower lateral cartilages, alar rim deformities can have both functional and aesthetic consequences.[1-3] Functionally, external valve collapse will result in difficulty with nasal breathing on inspiration.[4,5] From an aesthetic standpoint, a pinched or boxy tip with a poor alar-columellar relationship may be present. Weakness and/or malposition of the lower lateral cartilages can also result in alar notching and/or retraction, both of which lead to a displeasing alar-columellar relationship and overall poor tip aesthetics. Multiple techniques of varying complexity have been described to treat this common and challenging problem.[1-24]

Over the past two decades, alar contour grafts have been used as a simple yet effective rhinoplasty technique for improved contouring of the alar rim that involves the nonanatomic insertion of an autologous cartilage graft into a pocket along the alar rim. In both the primary or secondary rhinoplasty, the alar contour graft provides a foundation for reestablishment of a normally functioning external nasal valve, and an aesthetically pleasing nasal tip and alar contours. More recently, the extended alar contour graft has been used to prevent notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture.

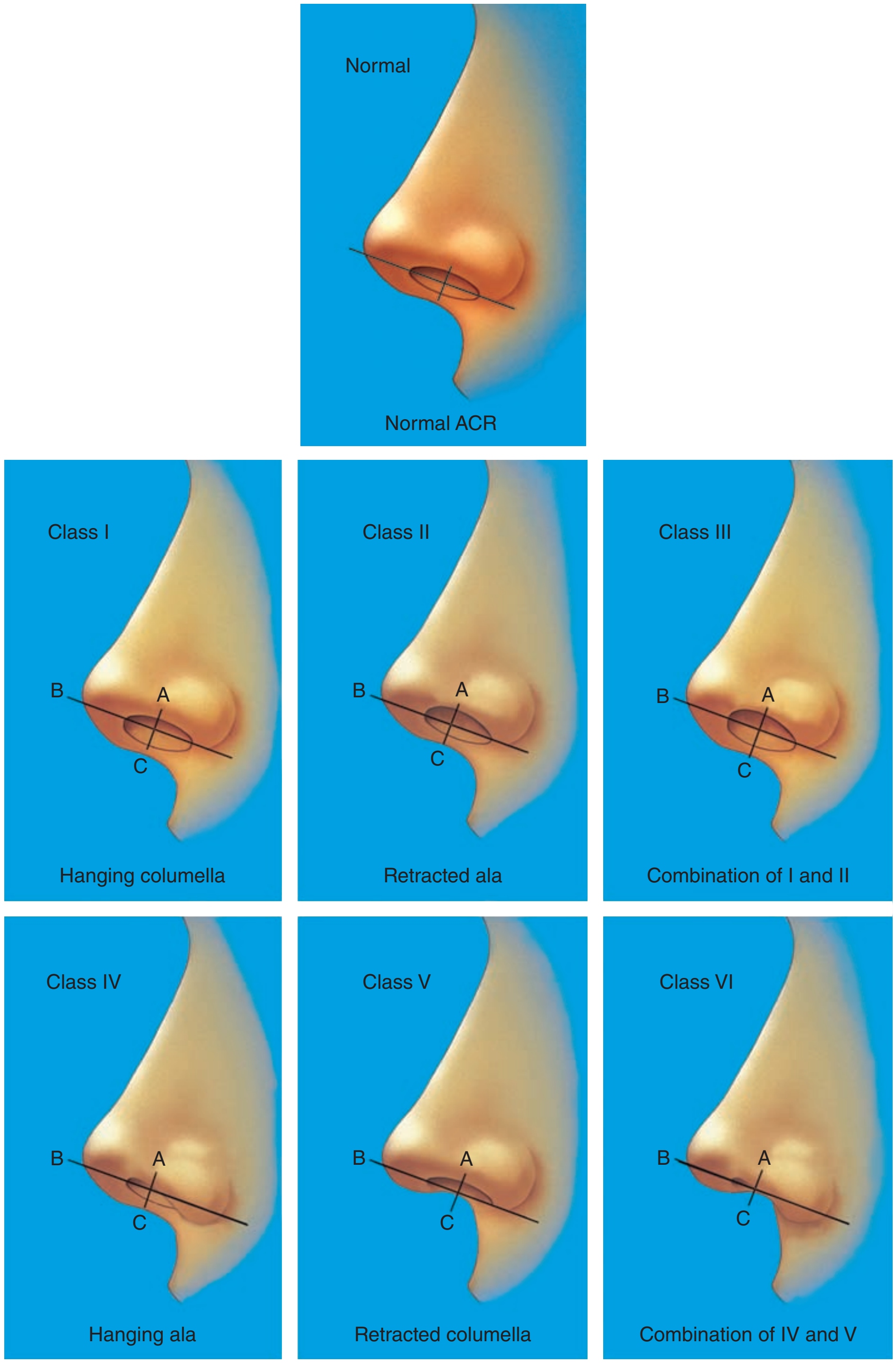
CLINICAL ANALYSIS AND ANATOMY

Ideal Aesthetics



On frontal view, Toriumi[6] emphasized the importance of a smooth transition between the tip complex and alar lobule. Otherwise, an undesirable shadow that isolates the tip can occur that increases the visual prominence of the tip. Rohrich and Liu[7] discussed specifically the aesthetics, underlying anatomical deformities and operative techniques to correct them for the infratip lobule.

Gunter et al[8] emphasized the importance of the alar-columellar relationship, as seen on lateral view, when analyzing the rhinoplasty patient. The ideal alar rim is oval shaped with a smooth contour, framed by the superior nostril border above and the columellar roll below. The greatest distance from the long axis of the nostril to either the columella or alar rim should be no more than 2 to 3 mm. In addition, the highest point of the alar rim should be located halfway between the transverse levels of the tip-defining points and the columellar-lobular angle.


Normal
Normal ACR
Class I
B
A
C
Hanging columella
Class II
B
A
C
Retracted ala
Class III
B
A
C
Combination of I and II
Class IV
B
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C
Hanging ala
Class V
B
A
C
Retracted columella
Class VI
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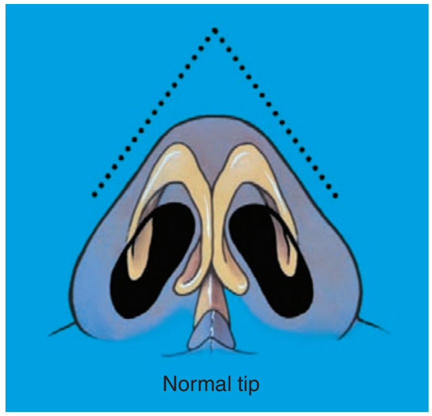
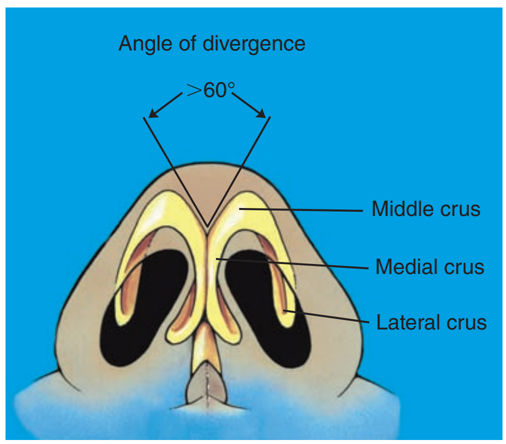
C
Combination of IV and V

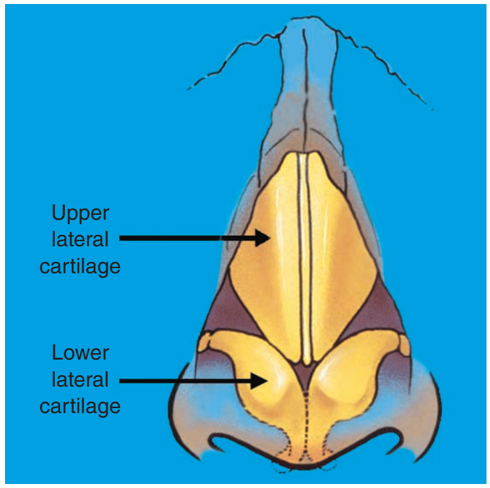


On basal view, the ideal alar rim reveals an equilateral triangle with slight alar flaring toward the alar base.

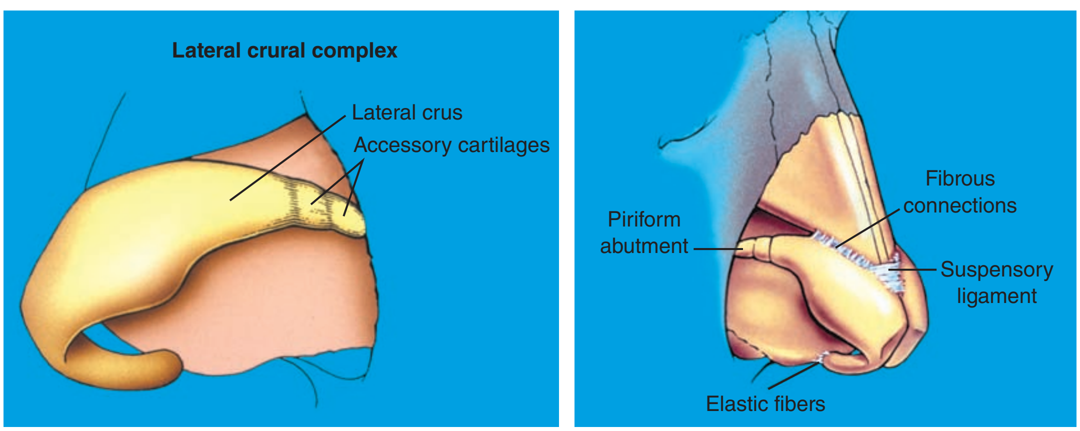
Anatomy



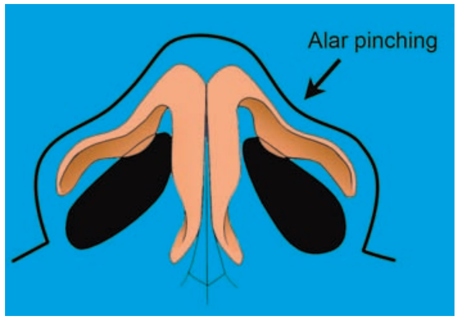
The lower lateral cartilage is the structural cornerstone for the alar rim and overall tip support.[9] Sheen and Sheen[10] divided the lower lateral cartilage into the medial, middle, and lateral crura. However, it is the strength, anatomic positioning, and orientation of the lateral crura that are paramount to the location, contour, and stability of the alae. External valve collapse, notching, and retraction can all become apparent when the lateral crus is unable to provide proper support for nasal soft tissues that become further stressed with inspiratory effort. In patients with alar rim collapse or weakness, this soft triangle appears notched from lack of underlying cartilaginous support. A boxy tip configuration can also contribute to weakness in the soft triangle area, leading to notching. Typically this notching occurs between the anterior third and the middle third of the alar rim on the basal or lateral view. Constantian[4,5] noted that the boxy and ball tip are often related to malpositioned and/or weak lower lateral cartilages.



The lateral crus initially runs parallel to the alar rim but then diverges from the anterior alar rim to attach to the accessory cartilage laterally. The accessory cartilages help form what is called the lateral crural complex by serving as a link between the lateral crus and the piriform aperture through a common perichondrium that permits them to act as a single functional unit. The lateral crural complex forms much of the support for the external nasal valve. Its points of attachment help provide support and include (1) the suspensory ligament of the tip, (2) the fibrous connections to the upper lateral cartilage, and (3) its abutment with the piriform aperture.



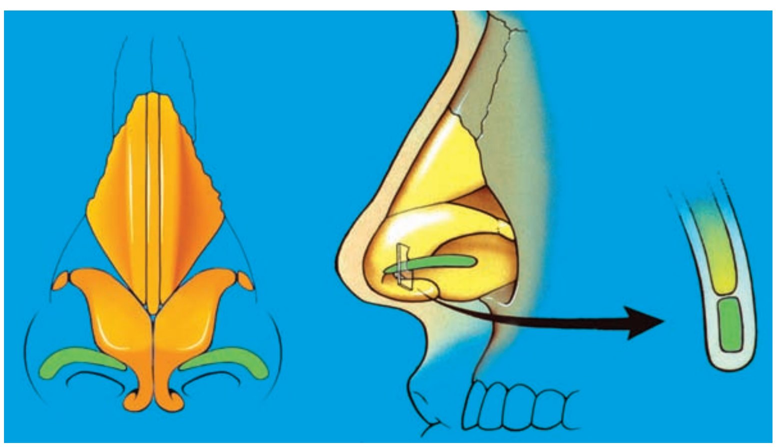
The area of actual cartilaginous support for the ala includes only its anterior half. The posterior 50% of the alar rim is composed of fibrofatty areolar tissue with thick overlying skin that is devoid of cartilage. This tissue composition of the posterior alar rim in addition to the action of the nasal dilator muscles lend further support to the ala but plays a relatively less significant role when compared to the cartilaginous lateral crural complex.



In addition to the strength of the lower lateral cartilages and its many attachments that form the lateral crural complex, the position and orientation of the lateral crus is also an important factor in its ability to provide support to the external nasal valve. The lateral crus should run parallel to the alar rim toward the lateral canthus. Cephalically oriented lateral crura that run toward the medial canthus are commonly associated with either boxy tips or alar notching.[4,5,11] In addition, the rotational orientation of the lateral crus is important in that the caudal and cephalic borders should be in the same horizontal plane.[6,7]

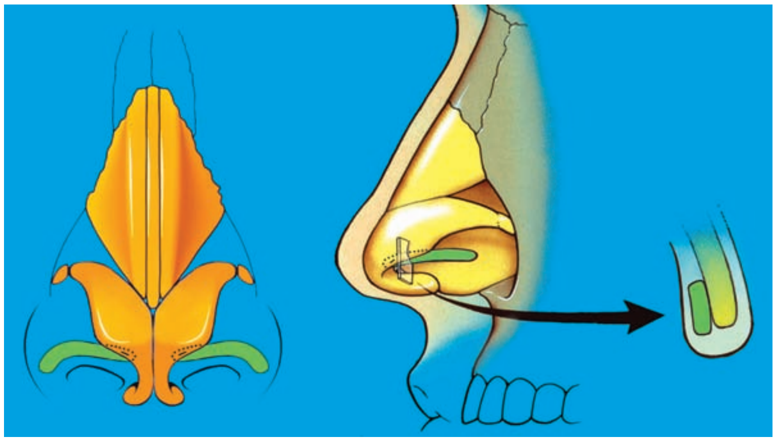
The strength, position, and orientation of the lateral crus are paramount to the location, contour, and stability of the ala.

INDICATIONS AND CONTRAINDICATIONS



The primary indications for the alar contour graft are as follows:
- Primary rhinoplasty patients with congenital alar rim notching
- Primary rhinoplasty patients with weak nasal alae/soft triangles with propensity for notching
- Primary or secondary rhinoplasty with mild to moderate external nasal valve collapse

- Primary or secondary rhinoplasty patients with malpositioned lower lateral crural cartilages
- Secondary rhinoplasty patients with minimal vestibular lining loss and at least 3 mm of residual lower lateral cartilage alar rim strips



The primary indications for the extended alar contour graft are as follows:

- The same indications as for alar contour grafts when more support of the alar rim is required
- Extended alar contour grafts will help control the rotational orientation of the lateral crus so that the caudal and cephalic borders are in the same horizontal plane
- Primary or secondary rhinoplasty patients with preexisting notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture

Extended alar contour grafts will help control the rotational orientation of the lateral crus so that the caudal and cephalic borders are in the same horizontal plane and are useful to correct preexisting notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture.

The alar contour graft and extended alar contour graft are not effective in patients with the following:

- Patients with significant vestibular lining loss as the cause of alar retraction
- Severe alar scarring (for example burn patients)
- No lower lateral cartilage remnant (the patients are better served with a lateral crural strut graft)
- Severe external nasal valve collapse

Other techniques such as the alar spreader graft[3] or the lateral crural strut graft[12] work well in more severe cases of alar retraction. In patients who have significant loss of lining or alar scarring, composite grafting may be indicated.[13-16] Rohrich et al[16] discussed the indications for several techniques addressing alar rim retraction, which are summarized in the table.

Surgical Techniques and Indications for Alar Rim Retraction

Technique	Degree of Alar Retraction Corrected	Graft Location	Efficacy for Lining Loss
ACG	≤2 mm	Alar rim	+
ASG	>2 mm ≤4 mm	Between LLC domes	+
LCSG	<4 mm	Beneath LLC medially to piriform aperture laterally	++
CG	>4 mm	Variable (alar rim area)	+++

ACG, Alar contour graft; *ASG,* alar spreader graft; *CG,* composite graft; *LCSG,* lateral crural strut graft.

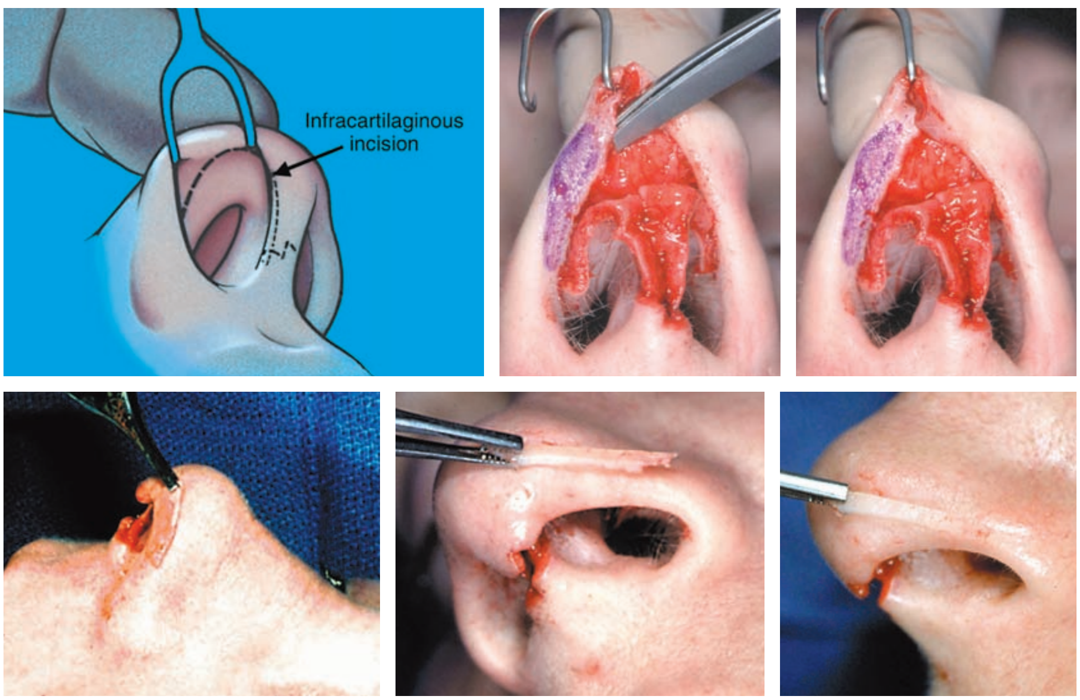
Alar contour grafts are indicated for primary or secondary rhinoplasty patients with minimal vestibular deficits, at least 3 mm of residual lower lateral cartilage, alar notching, or weakness or malposition of the lower lateral cartilage.

OPERATIVE TECHNIQUE

Alar contour grafts are commonly used during open rhinoplasty as the open approach allows direct visualization and correction of lower lateral cartilage deformities that contribute to alar rim deformities and/or external valve collapse. Again, this is most commonly caused by weakness, malposition, or poor orientation of the lower lateral cartilages, which ultimately lead to inadequate support for the alar rim.

In a primary rhinoplasty patient, use of the alar contour graft is based on the intraoperative analysis of the alar basal view after completion of the rhinoplasty and septal harvest of the cartilaginous graft. Septal cartilage is the first choice of graft material because it resides in the same surgical site, but an ear cartilage graft can be used if septum is unavailable. The amount of septal cartilage required for the typical alar contour graft is 2.5 to 6 mm (width) and 20 to 25 mm (length) per side. The dimensions of the graft are based on the shape and strength of the existing alar rims. The width is determined by the amount of support that is clinically indicated with 2 to 3 mm being the minimum amount necessary to provide any support. Narrow grafts (3 to 4 mm) are appropriate for patients needing minor

contouring or having a propensity for notching. Wider grafts (6 mm) are preferred for patients with external valve collapse or mild to moderate alar retraction. The length of the graft is then determined by the length that is necessary to span the particular defect. If there is alar retraction, a longer graft is needed that covers the length of the alar rim. With alar notching a shorter graft, closer to 20 mm is often adequate to span the area of notching which is most commonly where the alar groove is in line with the alar rim medially. When there is preexisting notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture, then an extended alar contour graft is required. In patients with secondary alar rim notching more scarring is usually present, and therefore a longer and slightly wider alar contour graft is often needed to correct the alar rim deformity.

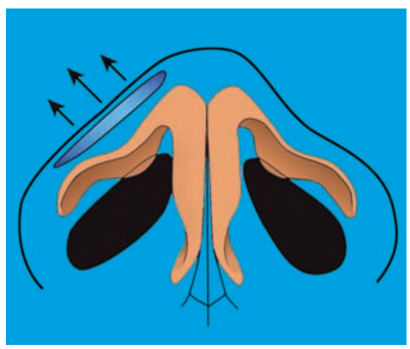


Scissors are used to dissect a pocket along the alar rim, inferior to the infracartilaginous incision. The opening is anterior, and the pocket should fit the alar contour graft precisely. When properly placed into this pocket, the graft should be invisible. If the graft does not correct the alar rim deformity, another graft can be layered on top of the existing one. The key to correction is to place the alar contour graft immediately above the alar rim and span the entire deformity.

The anterior edge of the graft often meets the lower lateral cartilage just below and lateral to the dome and helps support its caudal edge to keep it in proper orientation. Suture fixation of the graft is unnecessary if the pocket is dissected accurately. Both ends of the cartilage graft should be beveled. The posterior end

of the graft is beveled to help with initial insertion of the graft. The graft should be fashioned a few millimeters longer than what is required. This way once the graft fills its pocket, the excess graft can be trimmed with an oblique cut that is longer on the caudal aspect of the graft and shorter on the cranial aspect. This will allow the anterior end of the alar contour graft to approximate the caudal edge of the lateral crus where they abut. Such a maneuver enables maximal length/ support along the outer aspect of the alar rim while preventing overlap of the anterior end of the alar contour graft on the lateral crus resulting in visible irregularity adjacent to the lobule.

The extended alar contour graft is placed in a similar manner with the exception that a pocket is dissected between the vestibular skin and cartilage of the anterior aspect of the lateral crus. The anterior aspect of the extended alar contour graft is inserted into this pocket and can be sutured in place with a 5-0 PDS suture.



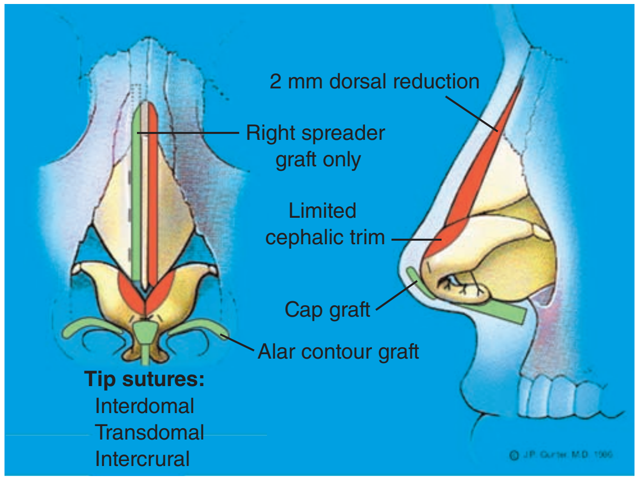
In addition to the aesthetic benefits, alar contour grafts are able to assist in correcting collapsed external nasal valves. The graft provides direct support for the external nasal valve based on its non-anatomic placement at the site of the external valve. In addition, placement of the alar contour graft displaces the lateral crura outwardly and thereby pulls the caudal end of the alar rim laterally by virtue of their soft tissue attachments. This helps maintain a more patent external valve as well.

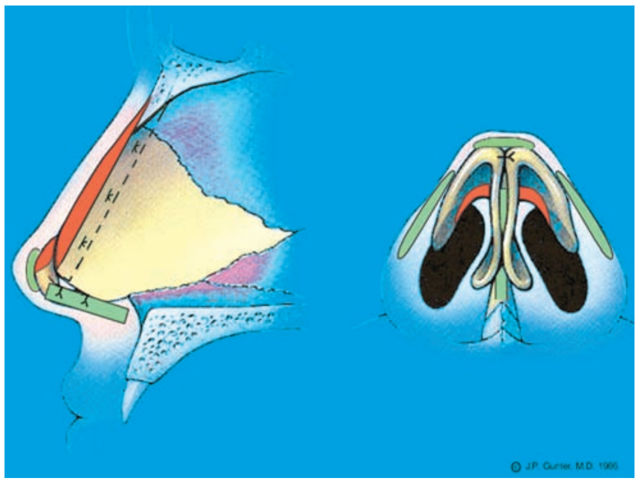
The alar contour graft is placed in a pocket immediately above the alar rim to span the defect.

CASE ANALYSES

This patient presented for a secondary rhinoplasty seeking correction of her deviated nose and ill-defined nasal tip. On the frontal view, she has Fitzpatrick type II skin with adequate facial proportions. Her nose deviates to the left with asymmetrical dorsal aesthetic lines. The nasal skin is thin, revealing a distorted and deviated nasal tip with contour irregularities. The lateral view demonstrates a shallow nasofrontal angle leading to a slight dorsal hump and supratip notching. The columellar-lobular angle is increased (obtuse) with an abnormal alar-columellar relationship. Alar notching is present on the lateral view with flaring. The basal and forehead views show the dramatic asymmetry and distortion of the nasal tip framework with dorsal nasal deviation. The nostrils are asymmetrical with grooving of the columella.

The treatment plan for this patient included correction of nasal deviation, dorsal hump, and collapsed external nasal valves and restoration of nasal tip framework and symmetry.





The operative goals included the following:

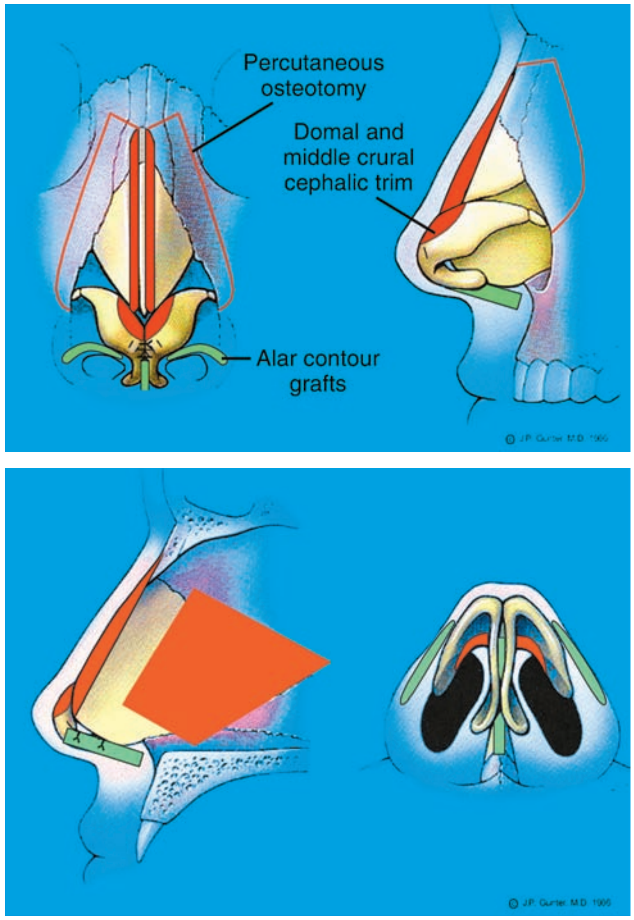
- Use an open approach with a transcolumellar incision and infracartilaginous extensions.
- Expose the distorted nasal framework and defining anatomy.
- Separate the upper lateral cartilage from the septum proper.
- Expose the nasal septum with harvest of septal cartilage.
- Perform component dorsal hump reduction (2 mm cartilage and bony reduction performed incrementally).
- Secure a right spreader graft to the dorsal septum with 5-0 PDS to straighten the deviated nose.
- Perform limited cephalic trim of the lower lateral cartilages, sparing the middle crus.

- Secure a columellar strut graft with 5-0 PDS intercrural sutures.
- Refine the tip with interdomal and transdomal sutures, and placement of a cap graft from the cephalic trim cartilages.
- Place alar contour grafts subcutaneously at the nasal vestibule to correct the weakened and collapsed external nasal valves.

The patient is shown postoperatively with a straight nose, improved dorsal aesthetic lines, and a balanced nasal tip, as seen from the frontal view. The lateral view demonstrates a smoother nasal dorsum with an improved nasolabial angle and alar-columellar relationship.

The basal and overhead views demonstrate restoration of symmetrical nasal framework with a straight columella and absence of grooving. Despite thin nasal skin, the patient's nasal contour irregularities have been corrected with smoother tip-defining points. The overhead view shows natural dorsal aesthetic lines with correction of alar notching.

This 18-year-old woman presented with a wide nasal dorsum, boxy tip, high dorsal deviation with a reverse-C deformity, alar notching bilaterally from the boxy tip (more on the left than on the right), and nasal airway obstruction. The lateral view shows a normal radix. She had a 4 mm dorsal hump that was primarily bony rather than cartilaginous, a nasolabial angle of 100 degrees, and a hanging alae. The basal view confirmed a boxy tip with thick skin and splaying of the medial crura, and alar notching bilaterally that was more pronounced on the left than on the right.

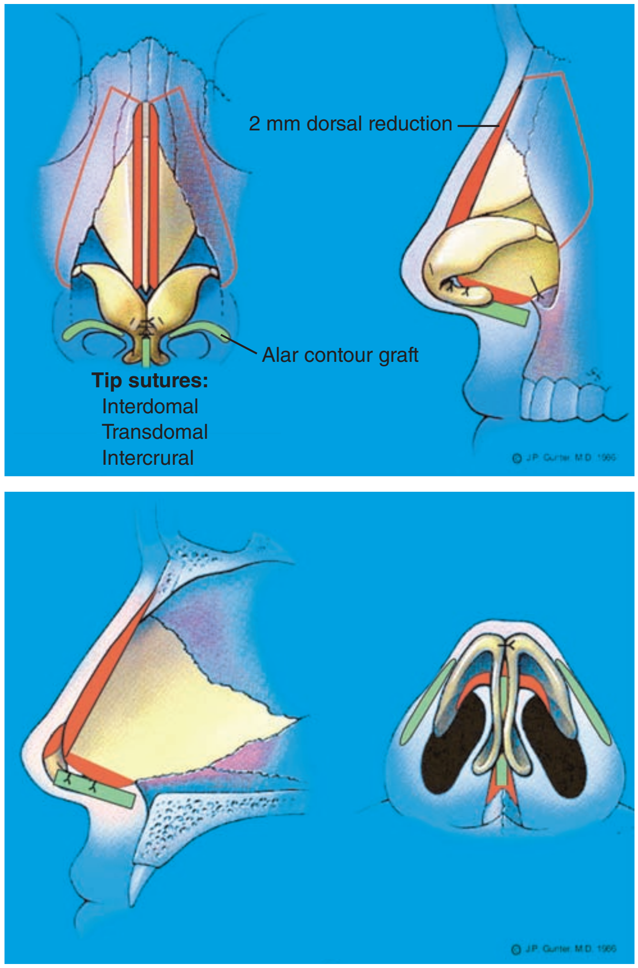


The operative goals included the following:

- Use an open approach with a transcolumellar incision and infracartilaginous extensions.
- Perform septal reconstruction and harvest.
- Perform a 3 mm component dorsal hump reduction.
- Place a columellar strut graft.
- Perform cephalic trim of the lateral and middle crura, leaving 6 mm of alar rim strip.
- Place intercrural, interdomal, and transdomal sutures.
- Place bilateral alar contour grafts to correct alar notching (left greater than the right).
- Perform percutaneous perforated lateral osteotomies.

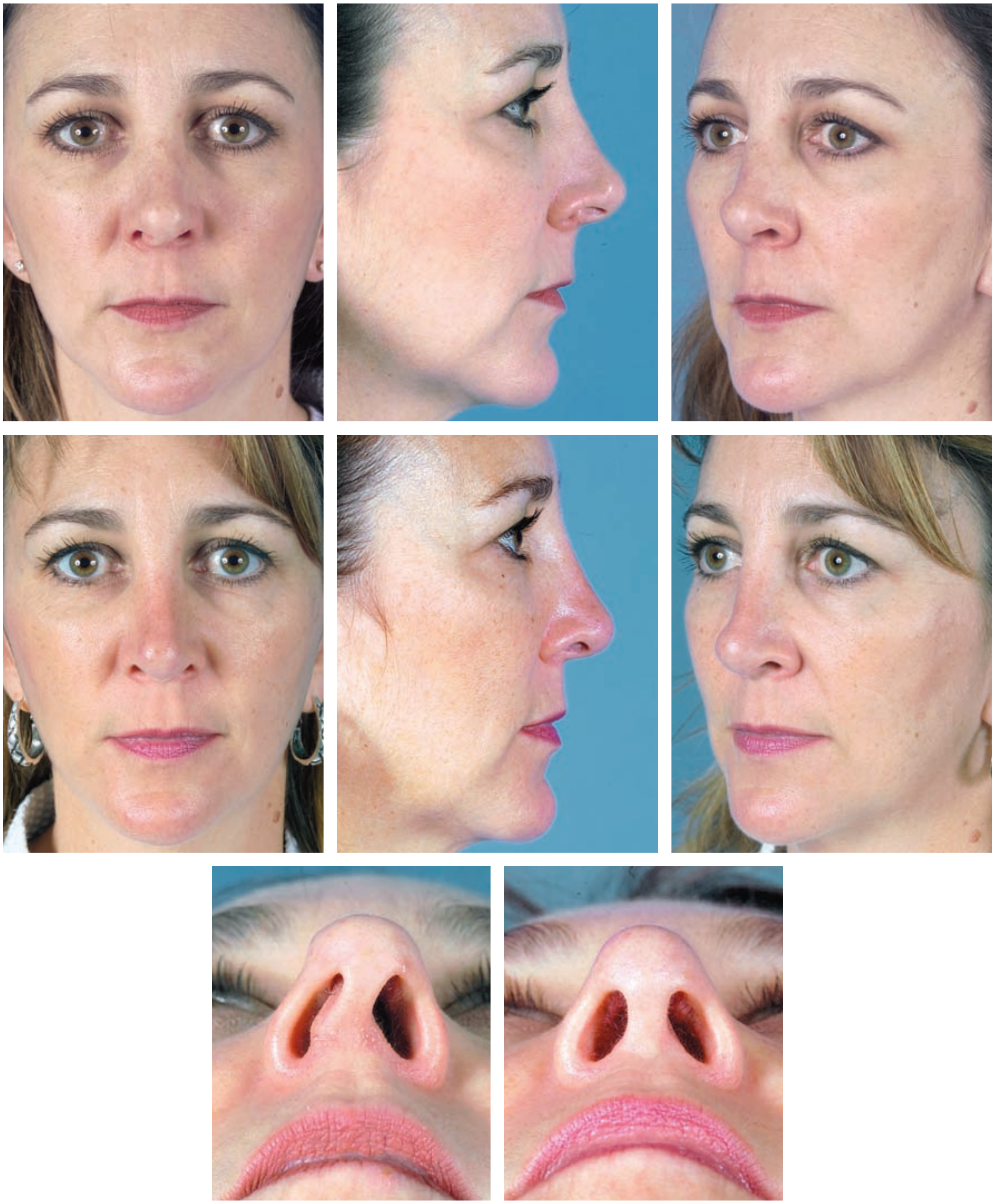
The patient is shown 12 months postoperatively with a straight dorsum, an improved nasal base–tip relationship, correction of the boxy tip, and refinement of the dorsum. The lateral view confirms a straight dorsal profile with a slight supratip break, a nasolabial angle of 95 degrees, an improved alar-columellar relationship, and normal tip projection. The basal view shows correction of alar notching with alar contour grafts and restoration of the columellar-lobular relationship.

This 42-year-old woman presented for secondary rhinoplasty. She had significant tip deformity with asymmetry and a boxy configuration. The columella was severely deviated to the left as a result of caudal septal deviation. She had weakened alae bilaterally, which was worse on the right. She had moderate alar notching on the right (basal view), and clinically there was external nasal valve collapse on this side.



The operative goals included the following:

- Use an open approach with a transcolumellar incision and infracartilaginous extensions.
- Perform a 2 mm component dorsal hump reduction.
- Place a columellar strut graft.
- Place a batten graft to the caudal septum.
- Use a figure-of-eight suture to secure the caudal septum to the anterior nasal spine.
- Place intercrural, interdomal. and transdomal sutures.
- Craft bilateral alar contour grafts from the remaining septum (9 mm wide, 2.5 cm long) to correct alar notching (left greater than the right) and external nasal valve collapse on the right.
- Perform percutaneous perforated lateral osteotomies.



The patient is shown 6 months postoperatively. The deviated columella, tip asymmetry, and the boxy tip have been corrected and the columellar-lobular relationship is normalized. The external nasal valve collapse and alar notching have been corrected with the alar contour grafts. The lateral view confirms maintenance of tip projection and a normal alar-columellar relationship.

COMPLICATIONS

Problems associated with alar contour grafts are rare. In some cases, the graft may be palpable or visible. This is encountered most frequently at the edge of the graft in secondary cases. Failure to correct or improve the notching or alar retraction is also possible but mostly dependent of the size and integrity of the graft material. Use of the extended alar contour graft to secure it to the lateral crus and correct notching of the anterior alar rim has helped to address problems in this area.

CONCLUSION

The alar contour graft is an effective and relatively simple technique that should be part of any rhinoplasty surgeon's armamentarium to treat aesthetic and/or functional alar rim defects. This technique may be indicated in the primary or secondary rhinoplasty patient with either alar collapse, malposition, retraction, and/or alar notching. Due to its nonanatomic alar rim placement, the alar contour graft provides the necessary support for correcting alar rim deformities and improves functional airway obstruction from collapse of the external nasal valve. In addition, it restores the natural contour to the alar rim, thereby improving alar symmetry.

KEY POINTS

- Alar rim deformities are one of the most common problems encountered in primary and secondary rhinoplasty patients.
- Congenital malpositioned lateral crura or from overaggressive surgical manipulation of the lower lateral cartilages, alar rim deformities can have both functional and aesthetic consequences.
- Alar contour grafts are a simple yet effective rhinoplasty technique for improved contouring of the alar rim that involves the nonanatomic insertion of an autologous cartilage graft into a pocket along the alar rim.
- The strength, position, and orientation of the lateral crura are paramount to the location, contour, and stability of the alae.
- Alar contour grafts are indicated for primary or secondary rhinoplasty patients with minimal vestibular deficits, at least 3 mm of residual lower lateral cartilage, alar notching, or weakness or malposition of the lower lateral cartilage.
- Extended alar contour grafts will help control the rotational orientation of the lateral crura so that the caudal and cephalic borders are in the same horizontal plane and are useful to correct preexisting notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture.
- The alar contour graft is placed in a pocket immediately above the alar rim to span the defect.

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28

Lower Lateral Crural Turnover Flaps

Michael R. Lee ▪ Jeffery E. Janis ▪ Rod J. Rohrich

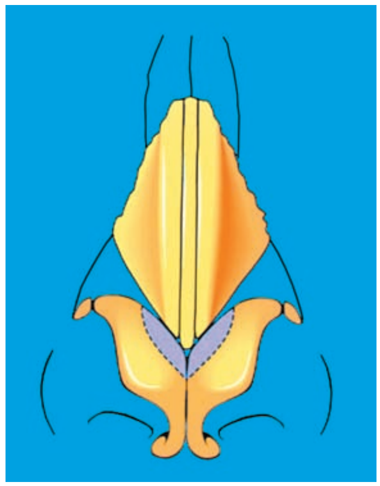
The aesthetic and functional properties of the nose are directly influenced by the position and shape of the lower lateral crura. Abnormalities in the shape or position of the lateral crura can lead to deformities of the nasal tip and alar contour lines.[1,2] In addition to aesthetic deformity, malpositioned or weakened lateral crura can provide insufficient support creating collapse of the external nasal valve.[3-5] Historically, abnormalities in the lateral crura have been treated with repositioning, cartilage grafting, and suture techniques with or without cartilage scoring or morselization.[4,5] Although adequate septal cartilage required for grafting is commonly present in the primary rhinoplasty patient, it is often depleted in revision operations. In addition, autologous grafts can suffer migration and contour irregularity during the dynamic effects associated with wound healing.

The position and shape of the lower lateral crura influence aesthetic and functional properties of the nose.

Techniques implementing scoring and suture manipulation can result in cartilage destruction and subsequent weakening.

Chapter adapted from Janis JE, Trussler A, Ghavami A, Marin V, Rohrich RJ, Gunter JP. Lower lateral crural turnover flap in open rhinoplasty. Plast Reconstr Surg 123:1830-1841, 2009.

Noticeable trends in rhinoplasty have focused on conservative measures that correct deformity while minimizing trauma to the existing framework.[6,7] Equally as important is that these measures are reliable and reproducible. It stands to reason that techniques employed with minimal trauma to the adjacent tissue will provide more consistent results, because less force is at play during wound healing.



The lower lateral crural turnover flap is presented in this chapter.[8] A modification of previously described techniques, the lower lateral crural turnover flap uses excess lateral crural cartilage to correct innate or iatrogenic deformities.[9] When sufficient lateral crural width is present, the cephalic portion can be transposed onto caudal cartilage to adjust the overall tissue properties. This maneuver maintains its vascularity via intact perichondrium, which optimizes longevity.[9] By employing the lower lateral crural turnover flap, the topographic abnormalities of the lateral crus can be corrected, weakened cartilage can be strengthened, and external valve collapse can be prevented or improved. The technique is able to accomplish these purposes while obviating the need for additional graft material and reducing local morbidity. The portion of lateral crus used is that commonly excised and discarded during cephalic trim. The flap may be used for unilateral or bilateral purposes.

Patients who are candidates for the lower lateral crural turnover flap must have a lateral crus wide enough to allow creation of the flap while maintaining 6 mm of caudal alar rim strip to prevent alar retraction.

INDICATIONS

Concave Lower Lateral Crura

Morphologic variations are common in the lower lateral crural cartilages. In an aesthetically pleasing nose, there is a smooth transition from the convexity of the dome to the concave anterior lateral crus.[3,5] As the lateral crus extends to join the accessory cartilages it becomes more concave. Deviation in the topography of the normal lateral crura anatomy leads to distortion of the external contour resulting in deformity of the nasal tip and alar arch.[4,10-13] When the lower lateral cartilage possesses an overall concave shape the lower lateral crural turnover flap can be used to address the existing deformity. The biomechanical correction results from transposition of a convex cephalic cartilage onto a concave caudal cartilage. The opposing forces improve tissue contour and allow improved tip definition with adjuvant suture techniques.

Lateral crura support is important for external valve support and airway patency.

Convex Lower Lateral Crura

In similar fashion, when the lateral crura are found to be largely convex, an external contour deformity can result. Once again, the ability to restore an aesthetic alar arch and nasal tip is impaired. The transposition of cephalic concave cartilage onto caudal convex cartilage provides opposing forces, which produce a more natural contour of the lateral crura.

Lower lateral crural turnover flaps can improve shape and strength of the lateral crus.

Weak or Thin Lower Lateral Crura

Wide variation exists regarding the size and strength of the lower lateral cartilages. Weak lower lateral cartilages are vulnerable and often result in local collapse during inspiration.[14-18] From an aesthetic perspective, weak lateral crura often complicate tip refinement and may compromise overall results. The lower lateral crural turnover flap, by definition, creates a bilaminar construct providing increased strength and durability. Secondary weakening of the lateral crura can occur from iatrogenic means of tip suture techniques particularly the commonly employed lateral crural steal.[19-21]

External Valve Collapse

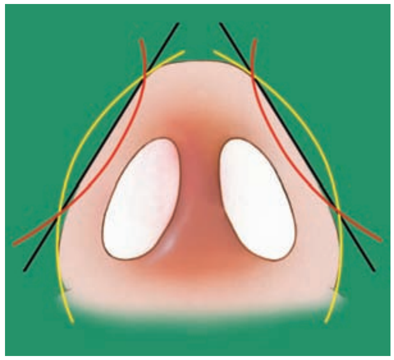
Weakened or malpositioned lower lateral crura frequently result in collapse of the external valve and ensuing nasal airway obstruction.[14-16] Utilization of the lower lateral crural turnover flap in these patients can fortify the external valve and alleviate the functional deficit. In patients with severe collapse, the lower lateral crural turnover flap may be used in combination with other described grafts such as lateral crural strut grafts, alar spreader grafts, alar batten grafts, and alar contour grafts.[10-11,22-23] Use of these additional grafts does not obviate or compromise the utility of the lower lateral crural turnover flap but rather work in conjunction with the flap. Of note, cartilage needed for these additional grafts is more readily available, since the lower lateral crural turnover flap does not require additional cartilage to perform. Furthermore, lateral crural strength suffers additional weakness if cephalic resection is performed concomitantly with tip suture techniques. Reinforcement of the lateral crus in this setting is imperative to prevent postoperative collapse of the external valve.

ETHNIC CONSIDERATIONS

Perhaps the ethnic nose stands to benefit the most from the lower lateral crural turnover flap. Although variations exist, these patients commonly posses a lateral crus with sufficient vertical height to perform this maneuver. Having a sufficient quantity of cartilage, however, does not necessarily equate to adequate lateral crural strength, and additional support may be required.[24-27] As previously mentioned, the initial width must be such that flap harvest leaves at least 6 mm of a residual caudal alar rim strip. Since tissue width is less commonly an issue in the ethnic nose, the lower lateral crural turnover flap can be often employed when the aforementioned indications are present. In addition to standard indications, iatrogenic deformation that may result from nasal tip elevation and alar base narrowing in the ethnic nose can be avoided by utilization of the lower lateral crural turnover flap.

ANATOMIC CONSIDERATIONS

Understanding lower lateral cartilage anatomy and their contribution to nasal aesthetics cannot be overstated. The lateral crura play a critical role in nasal contour and deviations in strength, shape, and position can lead to deformity of the nasal ala and external valve.[3-5] Vertically oriented lateral crura result in a poorly supported alar arch that is at a mechanical disadvantage in terms of patency. The result is an incompetent external valve and collapse upon inspiration.



An ideal nasal base forms an equilateral triangle with an existing mild alar flare toward the alar base.[8] On basal view, abnormal concavities or convexities can be elucidated relative to the position of the lateral alar outline. Alar concavity is diagnosed when the alar contour line is medial to the normal position of an equilateral triangle. Furthermore, abnormal convexity can be diagnosed when the alar contour line is found lateral to that of normal equilateral triangle position.

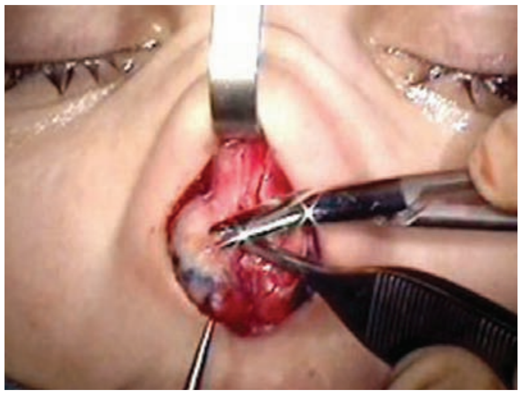
Malpositioned or morphologically abnormal lateral crura results in alar arch collapse and eludes an aesthetically pleasing nasal shape and contour.

OPERATIVE TECHNIQUE

Correction of the boxy tip is often addressed with cephalic trim of the lower lateral cartilage. Overresection of the cephalic portion can result in an insufficient residual caudal alar rim strip. This results in the secondary deformity of alar notching from compromised shape and strength of the remaining lateral crura. Additional complications of lateral crura overresection include weakening of the external valve and contour deformity.[3,28-29] These problems may also occur in cases where destructive cartilage scoring or crushing and tip-suturing techniques are employed without additional alar support. Insufficiency of the external valve and alar retraction are difficult problems to correct and should be prevented. The lower lateral crural turnover flap may serve to minimize the likelihood of this occurrence. When fashioning the lower lateral crural turnover flap, it is important for the surgeon to incise the full-thickness of the cartilage at both the anterior and posterior cartilage margins.

Equally important is the scoring of the entire length on the posterior lateral crus at the point where it will be folded over. These steps are critical in preventing tension on the flap corners, which may produce external visibility and palpability.

Meticulous tailoring of the graft edges is paramount to prevent contour deformity, especially in a thin-skinned patient.



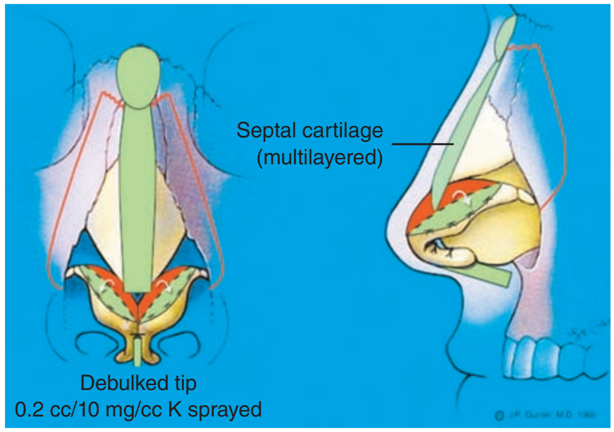
The lower lateral crural turnover flap is performed in the following manner[8]:

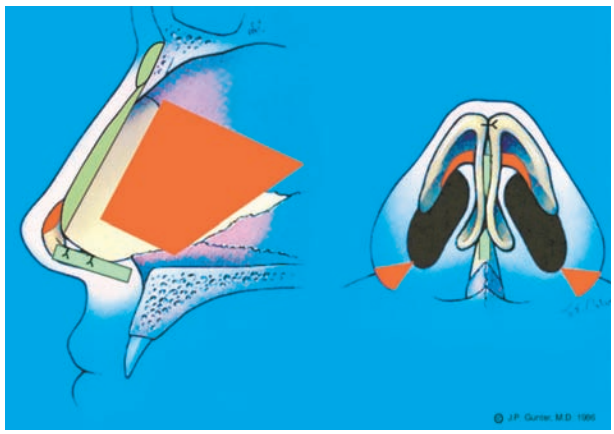
1. The open approach is used to provide adequate exposure of the lower lateral cartilages. The lower lateral crural turnover flap is performed before tip-shaping maneuvers.
2. A horizontal line bisecting the lower lateral cartilage at the lateral domal margin through to the superior junction of the lower lateral cartilage and accessory cartilage complex is marked.
3. The adherent cephalic vestibular skin is then infiltrated and hydrodissected with 1 ml of local anesthetic to facilitate dissection of the thin vestibular skin.
4. A 5 to 7 mm width of lower lateral cartilage is turned over, depending on the total width, thickness, and deformity of the cartilage. The average width of the native lower lateral cartilage should therefore be equal to or greater than 12 mm to accommodate preservation of a 6 mm caudal alar rim strip.
5. The vestibular skin is undermined off the entire cephalic border of the cartilage to the level of the markings on the superficial surface of the cartilage.
6. Full-thickness 2 mm incisions are made at the anterior and posterior aspects of the scored cartilage, and the remainder of the undersurface is scored with a No. 15 blade. The integrity of the superficial surface of the cartilage and its perichondrium is maintained.

7. The cephalic cartilage flap is then turned over onto the residual caudal cartilage, ensuring adequate release and mobility of the flap.
8. Forceps are used to stabilize and flatten the cartilage, while the turnover flaps are secured to each other with a series of three to four caudally based simple 5-0 Vicryl sutures. Incorporation of the vestibular skin in these sutures must be avoided.
9. The flaps are evaluated for adequate correction of the anatomic defect. The two-layer lower lateral cartilages should now appear flat, with a gentle concave orientation. This technique is employed before performing tip suturing and/or other alar rim grafting techniques. Depending on the tip shape desired, the medial extent of the turnover flap can be extended medial to the lateral genu to serve as an augmentative graft in the dome regions. The flap can be strengthened and augmented by incorporating an alar batten graft into the construct.

CASE ANALYSES

This 29-year-old woman had a slight dorsal hump, a wide dorsum, and a deviated, bulbous tip.[8]



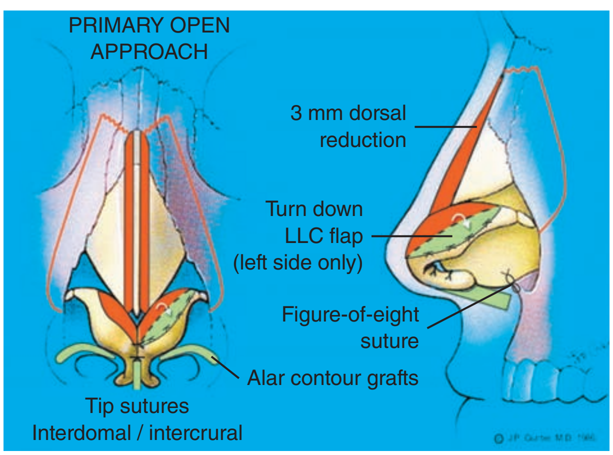


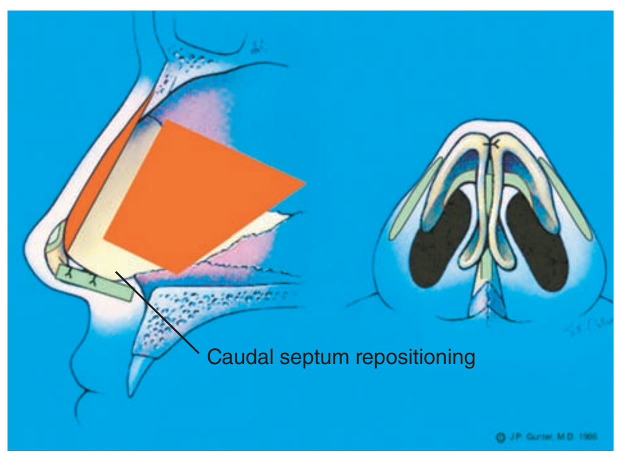
The operative goals included the following:

- Use an open approach.
- Reduce the dorsal hump.
- Harvest septum.
- Radix graft.
- Dorsal onlay graft.
- Bilateral lower lateral crural turnover flaps.
- Columellar strut graft.
- Tip sutures.
- Perform percutaneous perforated lateral osteotomies.
- Resect the alar base.

The patient is shown 1 year postoperatively. She has a straight dorsum, and her tip asymmetries have been corrected.

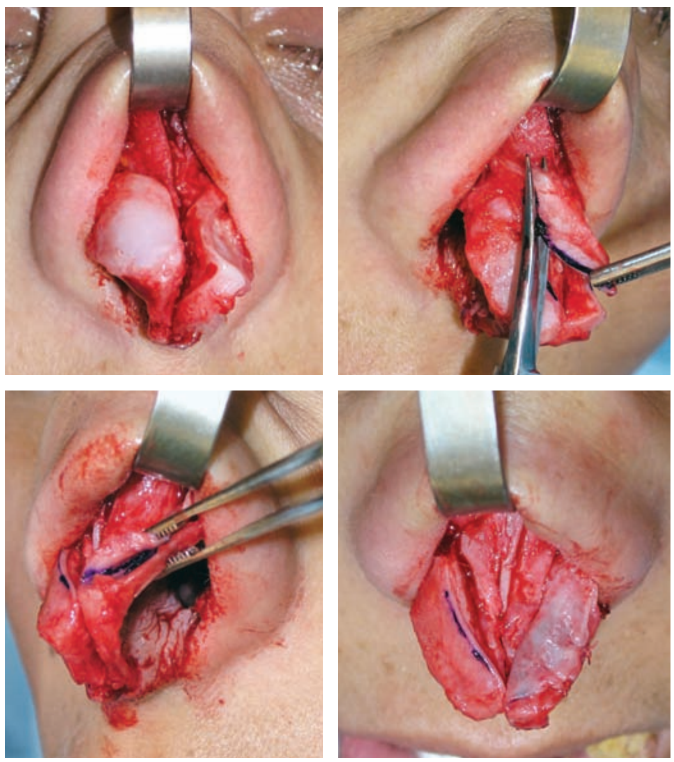
This 24-year-old woman had a slight dorsal hump, wide dorsum, and an asymmetrical, boxy tip.[8] In addition, she had left nasal airway obstruction.





The operative goals included the following:

- Use the open approach.
- Reduce the dorsal hump.
- Resect the caudal septum.
- Harvest septum.
- Create bilateral dorsal spreader grafts.
- Left lower lateral crural (LLC) turnover flap.
- Right cephalic trim leaving 6 mm alar rim strip.
- Bilateral alar contour grafts.
- Perform percutaneous perforated lateral osteotomies.



Intraoperative views show asymmetry of the lower lateral crura. A right cephalic trim was performed and a left lower lateral crural turnover flap was fashioned.

The patient is shown 1 year postoperatively. She has a straight dorsum and correction of her tip asymmetries.

KEY POINTS

- The position and shape of the lower lateral crura influence aesthetic and functional properties of the nose.
- Techniques implementing scoring and suture manipulation can result in cartilage destruction and subsequent weakening.
- Patients who are candidates for the lower lateral crural turnover flap must have a lateral crus wide enough to allow creation of the flap while maintaining 6 mm of caudal alar rim strip to prevent alar retraction.
- Lateral crura support is important for external valve support and airway patency.
- Lower lateral crural turnover flaps can improve shape and strength of the lateral crus.
- Malpositioned or morphologically abnormal lateral crura results in alar arch collapse and eludes an aesthetically pleasing nasal shape and contour.
- Meticulous tailoring of the graft edges is paramount to prevent contour deformity especially in the thin skinned patient.

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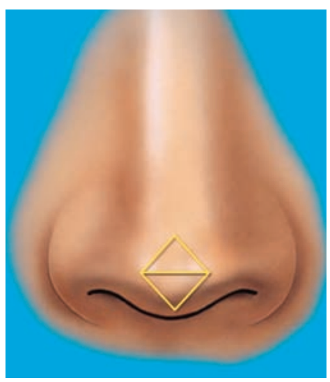
29

Lateral Crural Strut Grafts

C. Spencer Cochran ▪ Jack P. Gunter

The shape of the nasal tip is a result of the interplay of a multitude of factors, including the lower lateral cartilage width, domal width, angle of divergence of the middle crura, and even skin thickness. Although each of these factors influences the appearance of the tip, the shape, contour, and orientation of the lateral crura have a more profound aesthetic and functional impact on the tip *lobule* as a whole.



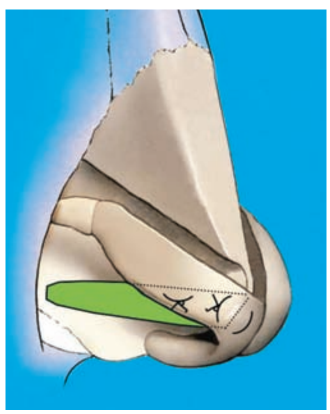
The ideal nasal tip has been described as having four distinct surface landmarks that form two equilateral triangles. These triangles form a diamond-shaped tip complex on frontal view. Toriumi[1] described an aesthetically pleasing tip as one in which there is smooth transition from the tip lobule to the alar lobule without a line of demarcation.

BACKGROUND

Modification of the lower lateral cartilage complex is the sine qua non of modern rhinoplasty, and the open approach to rhinoplasty has brought to light the extent of lateral crural abnormalities. Lateral crural abnormalities are a result of lateral crural shape, orientation, or a combination of shape and orientation. These abnormalities may be caused by primary deformities of the lower lateral cartilages or secondary deformities arising from weakened or overresected lateral crura from a previous surgery.

Lateral crural abnormalities are a result of lateral crural shape, orientation, or a combination of both.

Although a variety of methods have been proposed to correct lateral crural abnormalities, each technique addresses only a specific subset of patients.[2-14] We have found the lateral crural strut graft to be the most versatile tool for reshaping, repositioning, or reconstructing the lateral crura.



A lateral crural strut graft is a semianatomic graft placed on the undersurface of the lateral crus near the dome and extends laterally into pocket created in the alar sidewall. Lateral crural strut grafts allow the surgeon to comprehensively address both lateral crural shape and orientation to produce an aesthetically pleasing tip.

The aesthetic deformity and airway compromise created by attenuated or concave lateral crura can be corrected with lateral crural strut grafts.

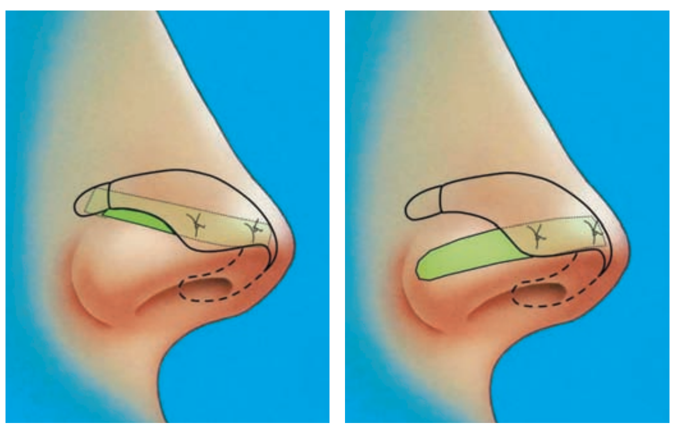
INDICATIONS AND CONTRAINDICATIONS

The original indications for lateral crural strut grafts, as described in 1997 by Gunter and Friedman,[15] included correction of a boxy nasal tip, malpositioned lateral crura, alar rim retraction, alar rim collapse, and concave lateral crura.

Lateral crural strut grafts are indicated for correction of a boxy nasal tip, malpositioned lateral crura manifested as the "parenthesis deformity," alar rim retraction, alar rim collapse, and concave lateral crura.

Since that time, we have expanded the role of lateral crural strut grafts and have found them to be useful in tip contouring, providing tip support and projection, total tip reconstruction, and in controlling rotation and nasal length. Lateral crural strut grafts require a significant amount of cartilage and should not be used for patients in whom a limited amount of cartilage is available as grafting material.

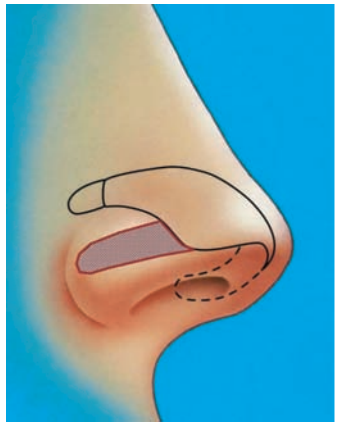
OPERATIVE TECHNIQUE



Although the original description of lateral crural strut grafts called for the graft to be situated deep to the entire length of the lateral crus, we now advocate placing the lateral extent of the graft in an alar pocket created caudal to the lateral crus–accessory cartilage junction. This provides support to both the peridomal region and the alar sidewall and rim.

To place a lateral crural strut graft, the vestibular skin must first be completely undermined from the undersurface of the lateral crus from the dome to the lateral crus–accessory cartilage junction. This undermining can be facilitated by

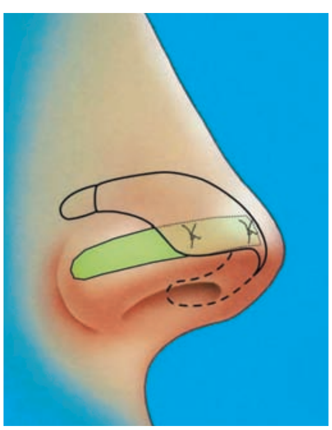
the infiltration of local anesthetic or saline to hydrodissect the thin vestibular skin from the cartilage. A cephalic trim, if desired, is performed before dissecting the vestibular skin from the cartilage.



Using the existing infracartilaginous incision, a pocket is created in the alar sidewall caudal to the lateral extent of the lateral crus. The shaded area depicts the extent of the subcutaneous pocket. The pocket should be below the level of the alar crease and extend to the alar-cheek junction. We have found that when the pocket is made low in the ala, it is not necessary to dissect past the alar-cheek fold, nor is it necessary for the graft to extend over the piriform rim.

A pocket is created in the ala caudal to the posterior extent of the lateral crus.

Autologous cartilage grafts are harvested and carved to measure approximately 4 mm wide and 18 to 25 mm long. Septal cartilage is preferred, but conchal or rib cartilage may be used.[16]



The graft is first placed in the pocket and then introduced under the lateral crus and positioned directly beneath the dome, where it is fixated with a transdomal suture placed on either side of the dome and includes the lateral crural strut graft. Laterally, the lateral crural strut graft is secured to the underside of the lateral crus with a horizontal mattress suture.

The lateral crural strut graft is placed on the deep surface of the lateral crus after developing a pocket by undermining the vestibular skin off the lateral crus to its caudal border.

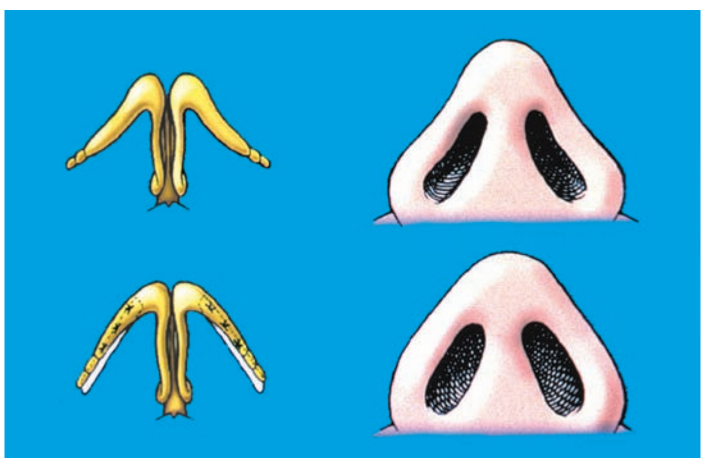
The lateral crural strut grafts, which are straight or slightly curved, are thicker and stronger than the lateral crura. When secured to the grafts, the lateral crura are strengthened and assume the shape of the grafts.

The lateral crural strut graft technique includes augmenting the strength and shape of the lateral crura with autologous cartilage grafts sutured on the deep surface of the lateral crura.

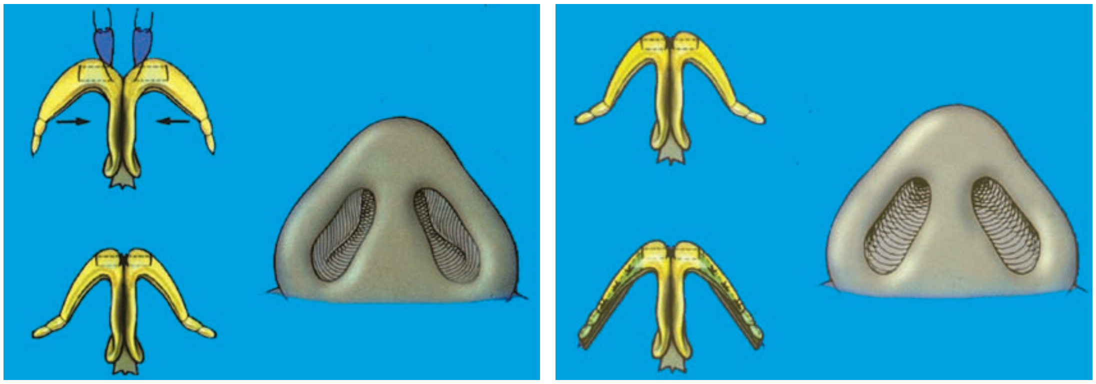
CASE ANALYSES

We have found lateral crural strut grafts useful in correcting the following deformities of the lateral crus.

Boxy Nasal Tip/Convex Lateral Crura/Concave Lateral Crura

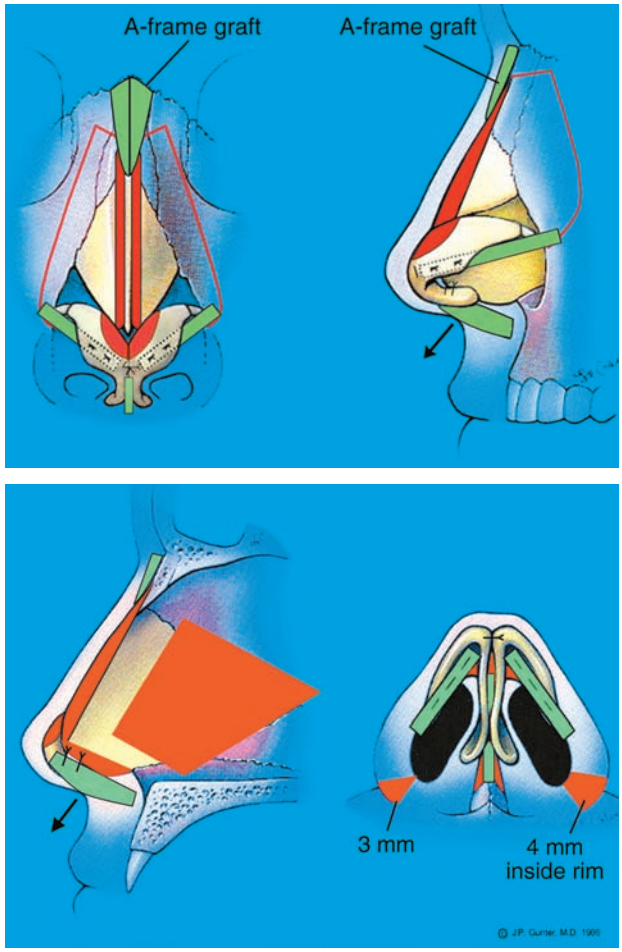


Lateral crural strut grafts are very effective for contouring lateral crura that are overly convex, as is the case in patients with boxy tips, as well as lateral crura that are concave. The lateral crura assume the straight shape of the lateral crural strut grafts, which add stability to the nostril rim and the external valve.



Lateral crural strut grafts will also prevent the medial collapse of the lateral crus–accessory cartilage junction that can occur when attempting to angulate the domes with transdomal sutures. Transdomal sutures can have a tendency to displace the lateral crus–accessory cartilage junction medially, compromising the nasal airway. Lateral crural strut grafts are useful in preventing or correcting this potential problem. Because the strut extends into the widest portion of the ala, the lateral crus is maintained in a lateralized location, which prevents the medial movement of the lateral crus that occurs as the transdomal suture is tightened.

Transdomal sutures and bilateral lateral crural strut grafts were used to correct this patient's boxy tip. The patient is shown 12 months postoperatively.



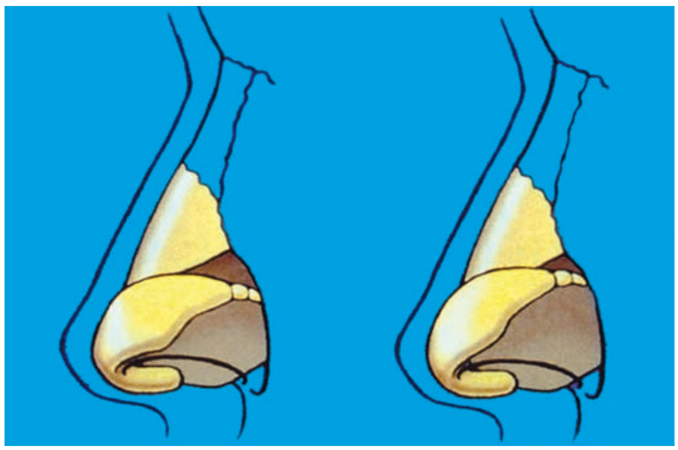
Surgical Plan

1. Use an open approach.
2. Place radix graft.
3. Perform medial and lateral osteotomies.
4. Place lateral crural strut grafts.
5. Place columellar strut.
6. Perform alar base reduction.

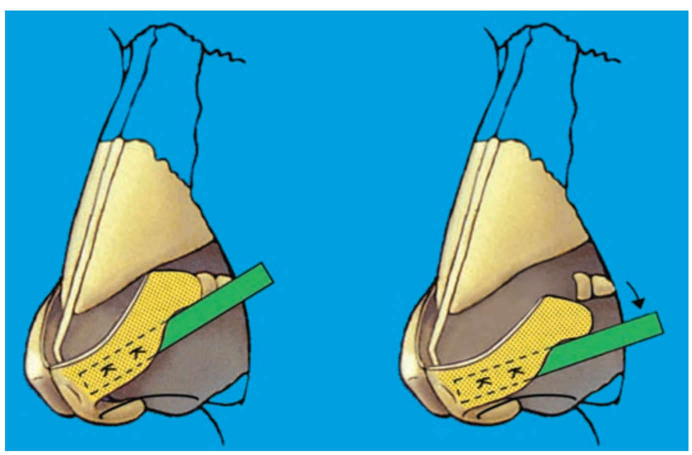
Transdomal sutures may produce a secondary deformity with medial displacement of the lateral portion of the lateral crura into the nasal vestibule, which can be corrected with lateral crural strut grafts.

Malpositioned Lateral Crura

Alar cartilage malposition, also referred to as *cephalically oriented lateral crura,* arises when the lateral crura deviate from the normal position paralleling the alar rim along the anterior half and then diverge from the alar rim at an angle greater than 45 degrees. In alar cartilage malposition, the lateral crus is oriented along an axis in line with the medial canthus, as opposed to the lateral canthus, leading to the characteristic parenthesis deformity of the nasal tip.[17]



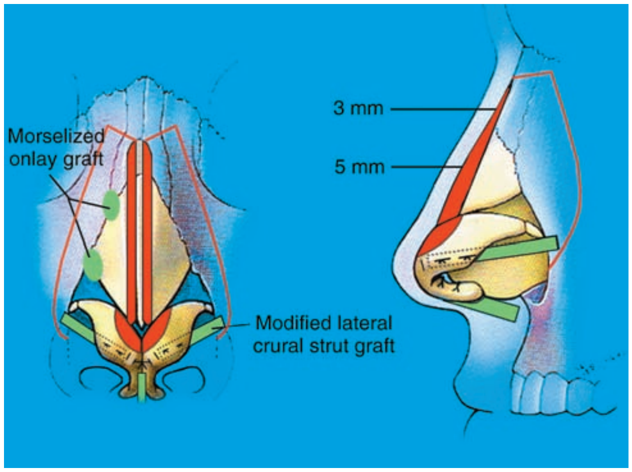
The contrast between the normal lateral crus on the left and the malpositioned one on the right can be seen. Correction of this anatomic variant is accomplished by using lateral crural strut grafts with lateral crural repositioning.

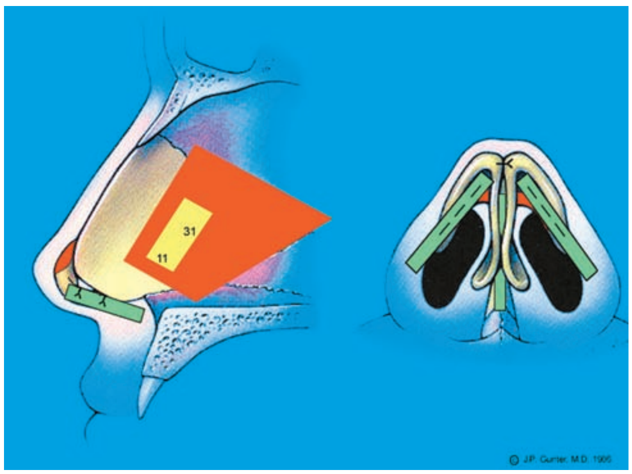


Repositioning of a cephalically oriented lateral crus is an effective means of correcting alar cartilage malposition. The vestibular skin is undermined from the undersurface of the lateral crus from the dome to the accessory cartilage junction,

where it is transected. The lateral crus is then supported with a lateral crural strut graft and caudally repositioned in a pocket created parallel to the alar rim. This repositioned lateral crus with the lateral crural strut graft provides support to the alar rim, straightens the convex caudal margin, and obliterates the parentheses.

This patient demonstrates how the malpositioned lateral crura (parenthesis deformity) can be corrected with lateral crural strut grafts that support the alar rims. The patient is shown 13 months postoperatively.





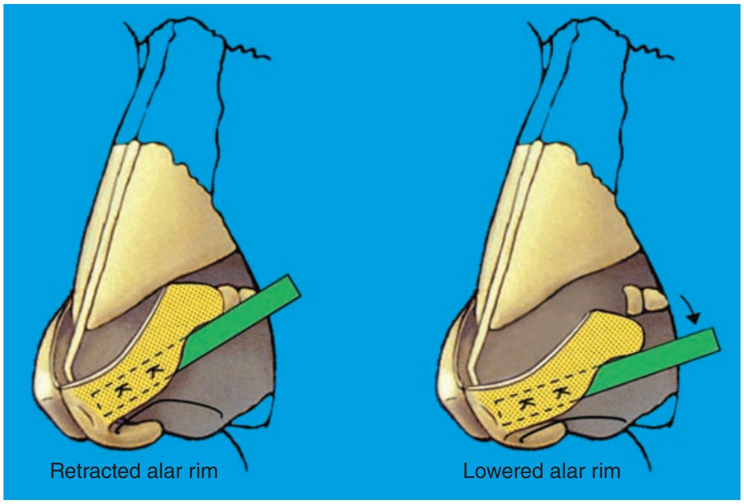
Surgical Plan

1. Use an open approach.
2. Reduce the dorsal hump.
3. Perform medial and lateral osteotomies.
4. Place lateral crural strut grafts with caudal repositioning of lateral crura.
5. Place columellar strut.

The parenthesis deformity and alar rim retraction can be treated with lateral crural strut grafts by placing the graft parallel to the alar rim in a nonanatomic fashion or by repositioning the lateral crus with an attached graft in a more caudal direction.

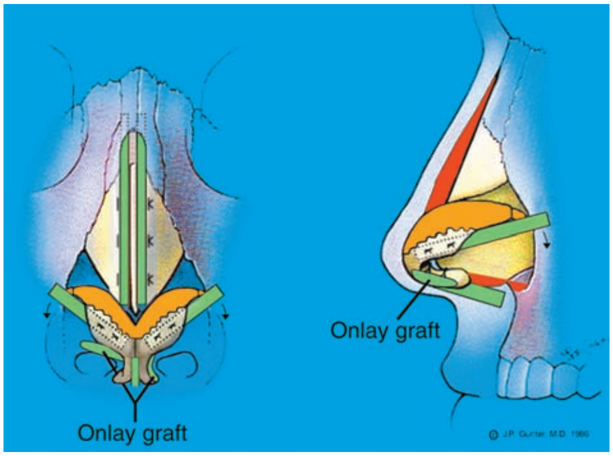
Alar Rim Retraction

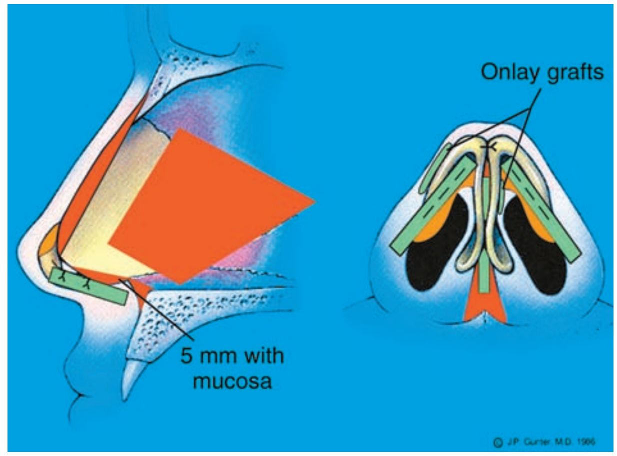
Lateral crural strut grafts are an effective means of correcting alar rim retraction, which is defined as a distance of more than 2 mm from the alar rim to the nostril long axis.[18]



A pocket is created low along the alar rim, the lateral crural strut graft is placed, and the lateral crus is repositioned caudally. Since the lateral crus is immediately adjacent to the retracted alar rim, lowering of the lateral crus results in lowering of the alar rim.

This secondary rhinoplasty patient demonstrates correction of alar retraction with lateral crural strut grafts and simultaneous correction of a hanging columella. The patient is shown 24 months postoperatively. The alar-columellar relationships have been significantly improved.

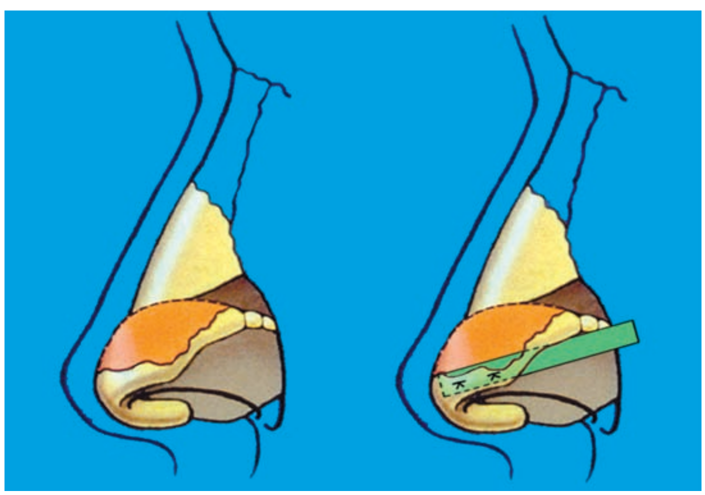




Surgical Plan

1. Use an open approach.
2. Place dorsal spreader grafts.
3. Place lateral crural strut grafts with caudal repositioning of lateral crura.
4. Place alar and columellar onlay grafts.
5. Place columellar strut.

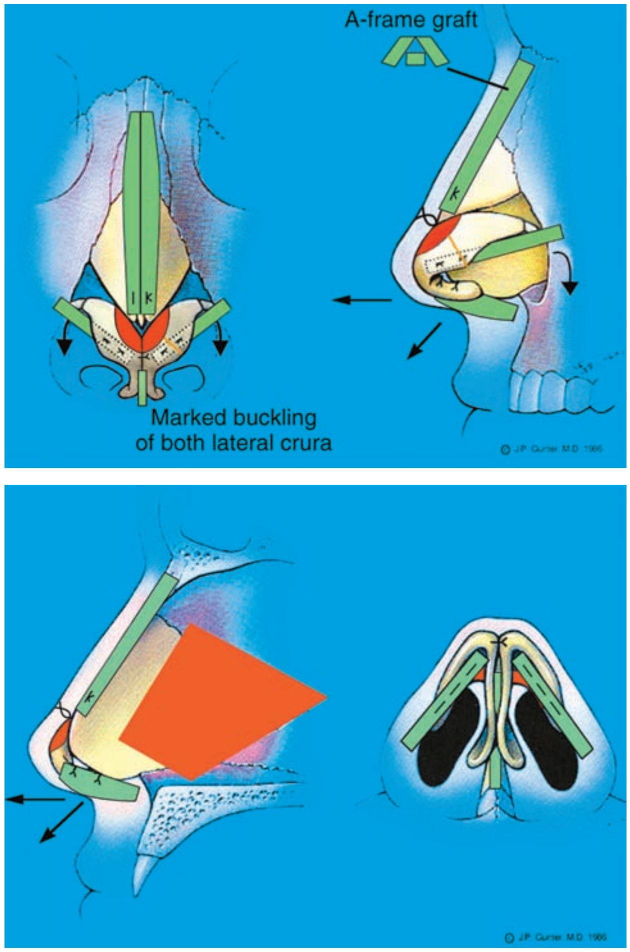
Alar Rim Collapse



Overzealous resection of the lateral crura may result in alar rim collapse as a result of severe attenuation or interruption of the alar rim strip.[19] The lateral crural strut graft can be used in secondary rhinoplasty procedures to strengthen tenuous

lateral crura or to reconstruct segmental crural defects. The lateral crural strut graft can be used in secondary rhinoplasty to reconstruct the lateral crura when they have been attenuated or interrupted by overresection.

This patient underwent secondary rhinoplasty for alar rim collapse after overresection of the lateral crura during primary rhinoplasty. The technique corrected the depressed alar grooves and the pinched appearance of the nasal tip. The patient is shown 14 months postoperatively.



Surgical Plan

1. Use an open approach.
2. Augment the dorsum with an A-frame dorsal onlay graft.
3. Perform medial and lateral osteotomies.
4. Place lateral crural strut grafts.
5. Place columellar strut.

ADVANTAGES AND DISADVANTAGES

Lateral crural strut grafts offer a rational and versatile solution to a wide array of lateral crural deformities and deficiencies. We have found them to be useful in contouring the tip in patients with boxy tips as well as in patients with overly convex or concave lateral crura. Similarly, they are effective at providing support to the alar side wall in patients with malpositioned lateral crura and alar rim collapse. Lateral crural strut grafts are the mainstay of our approach to tip

reconstruction in secondary rhinoplasty where the lateral crura are weakened or resected. They provide support and correct alar rim retraction.

We have chosen to place the grafts on the vestibular side of the lateral crura to provide a strong but invisible support. Graft placement superficial to the lateral crus is not recommended because of the risk of a visible step-off at the anterior end of the graft. All grafts are placed through the open rhinoplasty approach. Although it is technically possible to place these grafts through a closed approach, we believe open rhinoplasty facilitates accurate graft positioning and suture placement. Septal cartilage is the preferred material for the graft, but auricular and rib cartilage may be used.

Lateral crural strut graft placement superficial to the lateral crus is not recommended because of the risk of a visible step-off at the anterior end of the graft.

When placed low in the ala, the lateral crural strut graft helps to maximize lateral displacement of the lateral crus and minimize medial nostril movement on forced inspiration. It is not necessary to place the graft lateral to the piriform aperture rim, as originally described by Gunter and Friedman.[15] External valve patency is frequently improved with this technique, because the graft facilitates lateral movement of the alar wall.

To avoid a fullness where the strut crosses the rim, the end of the strut should be placed caudal to the alar groove. In correcting alar retraction or malpositioned lateral crura, the lateral end of the graft is placed along the entire length of the lateral crus, but its final position will be in a newly undermined pocket inferior to the groove.

The end of the lateral crural strut graft should be placed caudal to the alar groove.

If the nasal tip is narrow after lateral crural strut graft placement, a cartilage graft or the anterior end of a columellar strut may be placed between the medial walls of the domes. This will result in both an increased distance between the tip-defining points and a lateral movement of the anterior ends of the lateral crural strut grafts. When sufficient lateral displacement of the nostril wall cannot be achieved with lateral crural strut grafts alone, further displacement of the midportion of the crus may be obtained using alar spreader grafts.

Despite their many advantages, lateral crural strut grafts may be tedious and time consuming. They also require an adequate source of autologous cartilage, which may be difficult to obtain in a secondary rhinoplasty patient. Lateral crural strut grafts should be used only when simpler methods will not yield comparable satisfactory results. When properly planned and executed, they yield gratifying results for the correction of a diverse group of difficult primary and secondary rhinoplasty problems.

KEY POINTS

- Lateral crural abnormalities are a result of lateral crural shape, orientation, or a combination of both.
- Lateral crural strut grafts are indicated for correction of a boxy nasal tip, malpositioned lateral crura manifested as the parenthesis deformity, alar rim retraction, alar rim collapse, and concave lateral crura.
- The aesthetic deformity and airway compromise created by attenuated or concave lateral crura can be corrected with lateral crural strut grafts.
- A pocket is created in the ala caudal to the posterior extent of the lateral crus.
- The lateral crural strut graft is placed on the deep surface of the lateral crus after developing a pocket by undermining the vestibular skin off the lateral crus to its caudal border.
- The lateral crural strut graft technique includes augmenting the strength and shape of the lateral crura with autologous cartilage grafts sutured on the deep surface of the lateral crura.
- Transdomal sutures may produce a secondary deformity with medial displacement of the lateral portion of the lateral crura into the nasal vestibule, which can be corrected with lateral crural strut grafts.
- The parenthesis deformity and alar rim retraction can be treated with lateral crural strut grafts by placing the graft parallel to the alar rim in a nonanatomic fashion or by repositioning the lateral crus with an attached graft in a more caudal direction.
- Lateral crural strut graft placement superficial to the lateral crus is not recommended because of the risk of a visible step-off at the anterior end of the graft.
- The end of the lateral crural strut graft should be placed caudal to the alar groove.

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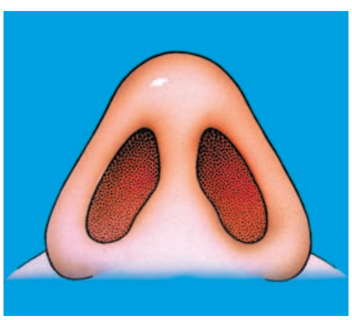
Correction of Alar Rim Deformities: Alar Spreader Grafts

Jack P. Gunter ▪ Rod J. Rohrich ▪ Jamil Ahmad

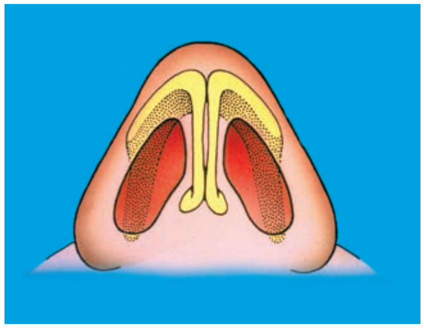
The pinched nasal tip deformity results from collapse of the alar rims subsequent to loss of lateral crural support from either congenital or acquired causes. A pinched nasal tip detracts from nasal aesthetics and, if severe, impedes nasal airflow during inspiration.[1,2] Alar spreader grafts can correct the aesthetic and functional deformity of a pinched nasal tip. They are derived from autologous septal, ear, or rib cartilage and can be placed in such a manner that they spread the collapsed lateral crura and buttress them from beneath.[3]

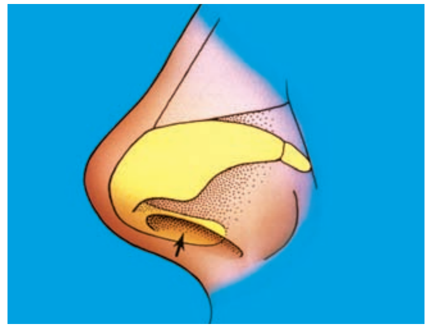
ALAR RIM ANATOMY AND AESTHETICS



Viewed from below, the ideal nasal base resembles an equilateral triangle with an outward bowing of the posterior alar rims and a rounding of the nasal tip. Although the resilience of the alar rims is influenced by the thickness of the skin and the action of the nasal dilator muscles, it is the strength and position of the lateral crura of the lower lateral cartilages that determine the condition of the alae.[4-7]

Chapter adapted from Gunter JP, Rohrich RJ. Correction of the pinched nasal tip with alar spreader grafts. Plast Reconstr Surg 90:821-829, 1992.





The caudal margin of the lateral crus runs posteriorly from the dome area, parallel to the alar rim, for up to half its length before it curves cephalad.[4,8] When the lateral crus is weak, the anterior and midportion of the rim may collapse because these areas are directly supported by the lateral crus, whereas posteriorly the rim has no cartilage support and is held in position by the thick alar skin.[5,9,10]

A weak lateral crus may result in alar rim collapse.

ALAR RIM COLLAPSE AND THE PINCHED NASAL TIP

Alar rim collapse can be congenital or traumatic, but it most often results from excessive resection of the lateral crus of the lower lateral cartilage during cosmetic rhinoplasty. Inadequately supported by cartilage, the nostril rim caves in under the weight of the skin. This collapse is often exacerbated by negative pressure in the nasal vestibule on inspiration. When the collapse is bilateral, the nasal tip looks pinched and on the basal view has a cloverleaf shape. In severe cases the collapsed rims limit the volume of air that can flow through the nose.[2,9-11]

Alar rim collapse can be congenital or acquired. Most often it results from excessive resection of the lateral crus of the lower lateral cartilage during cosmetic rhinoplasty.

ALAR SPREADER GRAFTS

Alar spreader grafts can be used to correct the aesthetic and functional deformity of a pinched nasal tip. Additionally, their placement can help to strengthen the lateral crura and control the shape of both the nasal tip and alae. Several modifications of alar spreader grafts have been used. The shape of the graft depends on

the severity of the collapse and other factors related to the tip. The exact dimensions of the graft vary from patient to patient. The graft should extend horizontally across the tip to push existing concavities in the crura outward.

An alar spreader graft technique offers versatility and durability of results after correction of a pinched nasal tip deformity caused by collapsed lateral crura.

Functionally, alar spreader grafts strengthen the vestibular walls and improve nasal respiration by correcting severely collapsed alar rims and increasing the opening of the internal nasal valves in some situations.

Aesthetically, alar spreader grafts improve the contour of the alar rim and nasal tip with the use of autologous semirigid tissues that provide long-lasting results.

OPERATIVE TECHNIQUE

The open approach is used to expose the lower lateral cartilages and identify the structural abnormalities that contribute to the deformity.[12] If one crus is missing or cannot be used for reconstruction, we prefer to replace the crus with a piece of auricular cartilage carved to the shape and contour of a normal crus. An extension is maintained on the medial end of the graft and sutured to the remaining intact anterior end of the medial crus. The graft is then bent at the area of the dome and suture stabilized at the desired angle with a horizontal mattress suture. If reconstruction of both crura is required, ear or an anchor graft of autologous cartilage can be used, as described by Juri et al.[13] However, we prefer autologous rib cartilage to rebuild the lower lateral crura.

In patients in whom the lateral crura have been completely resected or are so distorted that they cannot be used for reconstruction, the crura must be reconstructed.

When strips of lateral crura 2 mm or more in width are still present bilaterally, an alar spreader graft is used to bridge the space between them and to push these remnants laterally to correct the collapse. Septal cartilage is our first choice of graft material because it is in the same surgical area,[14-18] but conchal or rib cartilage can be used if septal cartilage is not available.

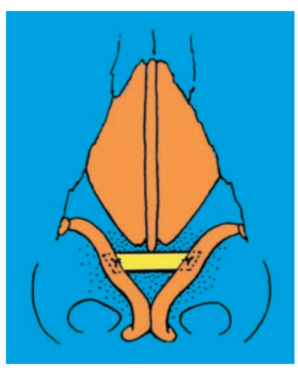
In patients with 2 mm or more of lateral crural width, an alar spreader graft can be used to spread the remaining strips of lateral crura laterally to correct the collapse.

Alar spreader grafts can be used in conjunction with other techniques to shape the tip or strengthen the alar rims. Although these grafts can help to strengthen the lateral crura and control their shape, the use of alar contour grafts will add further support to the alar rims and help to prevent deformities, including alar rim collapse, retraction, and notching.

The most difficult part of this technique to master is accurate prediction of the width of the graft needed for correction of the functional and aesthetic deformities before it is carved. The wider the graft, the more likely it is to improve function, but at a certain point it begins to detract from the aesthetic appearance. To estimate the desired graft length, we pass a needle through the collapsed segments of the crura and slide the cartilages on the needle until they become slightly convex. The length of the needle between the cartilages is the distance the graft must span, and it is carved accordingly.

Some problems associated with the alar spreader graft technique are inadequate correction and/or tip asymmetry postoperatively. These problems typically result from grafts of improper size or shape, or inadequate stabilization.

Single Subdomal Bar Graft



A single bar graft is usually sufficient to correct bilateral collapse in the midportion of the crura. To prepare the recipient sites to accept the ends of the graft, bilateral pockets are undermined between the areas of greatest collapse of the cartilage and the vestibular skin. Undermining begins at the cephalic margin of each crus and stops at the caudal margin. A 1½-inch 25-gauge needle is passed across the septal angle through the collapsed segments of the crura. The skewered crura are pushed laterally on the needle until they begin to bow outward.

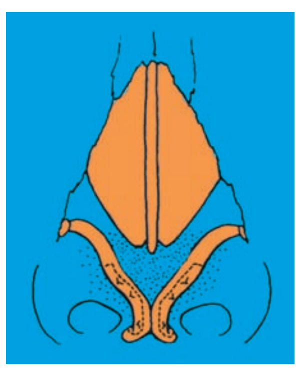
The distance between the cartilages is then measured along the needle, and the cartilage graft is carved to the same length. The graft ends are inserted in the pockets deep to the collapsed crura and are sutured to the crura with horizontal sutures of 5-0 PDS. Care is taken to not penetrate the vestibular skin.

The skin is redraped over the nasal tip to assess the effect. If the graft is too long, the tip will be too broad and the nostrils will flare, in which case the graft must be removed and trimmed to the desired length. If the graft is too short, the tip will still look somewhat pinched, and a longer graft is indicated. In all cases the goal of grafting is to separate the lateral crura to correct alar collapse but not so much as to cause nostril flare.

If the graft is too long, the tip will be too broad and the nostrils will flare.

If the distance between the alar rims appears to be correct but the tip is leaning to one side, the tip can be restored to the midline by shifting the graft so that the length of the graft is shorter on the side to which the tip is leaning. This asymmetrically placed alar spreader graft is anchored to the septal angle with 5-0 PDS suture. Unilateral alar rim collapse is corrected with an alar spreader graft that pushes the collapsed lateral crus outward. The graft is suture stabilized to the septal angle to prevent the collapsed crus from returning to its original position and displacing the normal crus.

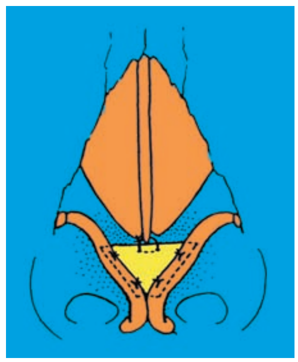
Caudal Subdomal Graft



A caudal subdomal graft can be used when the lower lateral crura are very weak and flimsy and unamenable to tip-suturing techniques. This is the case when the existing lower lateral crura are very thin or the alar rim strip is excessively narrow. A caudal subdomal graft can be added to increase strength to the domal region, including the middle crus and the anterior aspects of medial and lateral crura. After an infracartilaginous incision has been made, a pocket for this graft

is created by dissection of the vestibular skin away from the caudal margin of the domal region of the lower lateral crus; this should include the middle crus and anterior aspects of the medial and lateral crura. The graft should be about 3 mm wide and long enough to span the undersurface of the anterior aspect of the medial crus, middle crus, and anterior aspect of the lateral crus. The caudal subdomal graft is sutured to the deep surface of the lower lateral crus using 5-0 PDS. The graft will have the effect of pushing the lateral crus outward. Tip-suturing techniques can then be performed to titrate this effect.

Triangular Graft

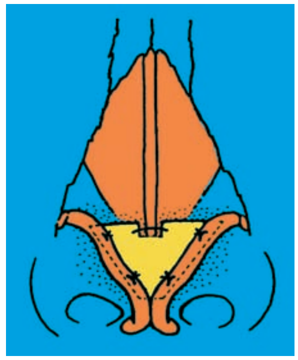


When additional support is needed for better tip definition or to increase tip projection, a triangular graft is used. In such cases the graft pockets are undermined from the collapsed portions of the crura caudally to the domes so that the remaining strips of lateral crura overlap the lateral edges of the triangular graft. The graft should be carved so that the base is wide enough to push the collapsed crural strips outward into their desired positions. The apex of the graft extends to the undersurface of the domes. The lateral crural strips are sutured to the lateral edges of the graft just short of the dome areas. This maneuver aids in stabilizing the domes for suture positioning and shaping. The midportion of the base of the graft is sutured to the septal angle to further stabilize the graft.

To accentuate the tip-defining points, angulation at the domes is increased by passing a horizontal mattress suture of 5-0 PDS through the medial and lateral surface of each dome, tying the knot on the medial surface and tightening until the desired angulation is achieved. To decrease the distance between the tip-defining points, one end of each knot is tied and tightened until the desired distance is confirmed.

If tip projection is short of ideal, the length of the triangular graft is increased to elongate the lateral edges of the graft. The alar rim strips are advanced on the edges and sutured to increase the projection. The domes are then shaped with tip sutures.

Extended Triangular Graft



If the problem is collapse of the posterior alar rim, the triangular alar spreader graft can be designed with posterolateral extensions sufficiently wide enough to push the collapsed posterior alar rims outward.

If an alar retraction component is present in addition to alar rim collapse, a triangular graft slightly wider than needed is sutured to the collapsed alar rim strips, and a partial-thickness incision is made along the midline. The halves are squeezed to create a hinged fracture along the incision line to force the caudal edges of the graft inferomedially. The angular prominence of the hinge at the base of the graft is excised using a No. 15 blade. The base is sutured to the septal angle with a 5-0 PDS horizontal mattress suture to ensure that the graft remains bent, pushing the alar rims downward.

An additional benefit of alar spreader grafts is that they can sometimes assist in the correction of collapsed internal valves. This occurs when the scar tissue between the resected cephalic margin of the lateral crura and the caudal end of the upper lateral cartilages created by previous surgery is left intact.

Alar spreader grafts can help to correct collapsed internal nasal valves.

Placement of the graft displaces the lateral crura outward and simultaneously pulls the caudal end of the upper lateral cartilages laterally through the force of the scar tissue attachment. The lateral movement of the upper lateral cartilages increases the opening of the internal valves.

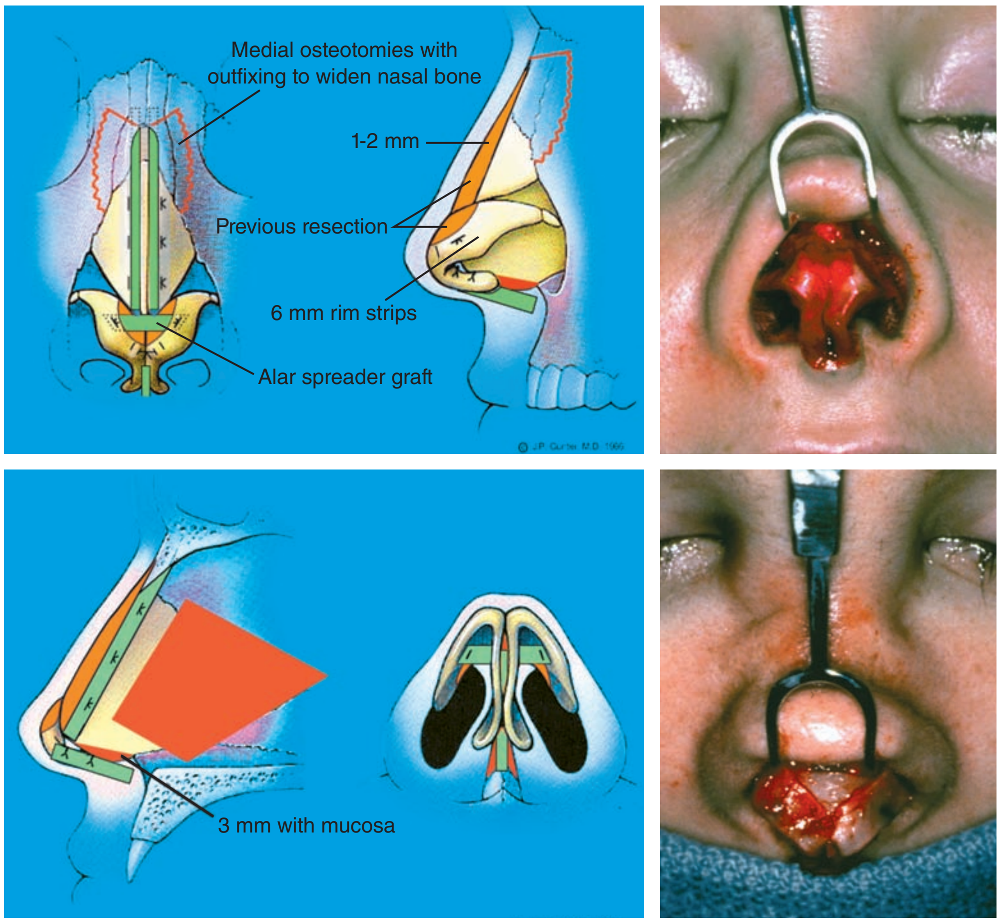
CASE ANALYSES




This 32-year-old woman underwent rhinoplasty 8 years previously and was dissatisfied with the aesthetic result.[3] She also had mild difficulty breathing through her nose. On the frontal view the midportion of her nasal dorsum was narrowed, the tip pinched, and the infratip lobular height increased. The lateral view revealed increased columellar show and increased infratip lobular height. The oblique view confirmed the frontal and lateral findings. The basal view showed bilateral collapse of the anterior alae with a cloverleaf appearance and increased distance between the tip-defining points.

The operative goals included the following:

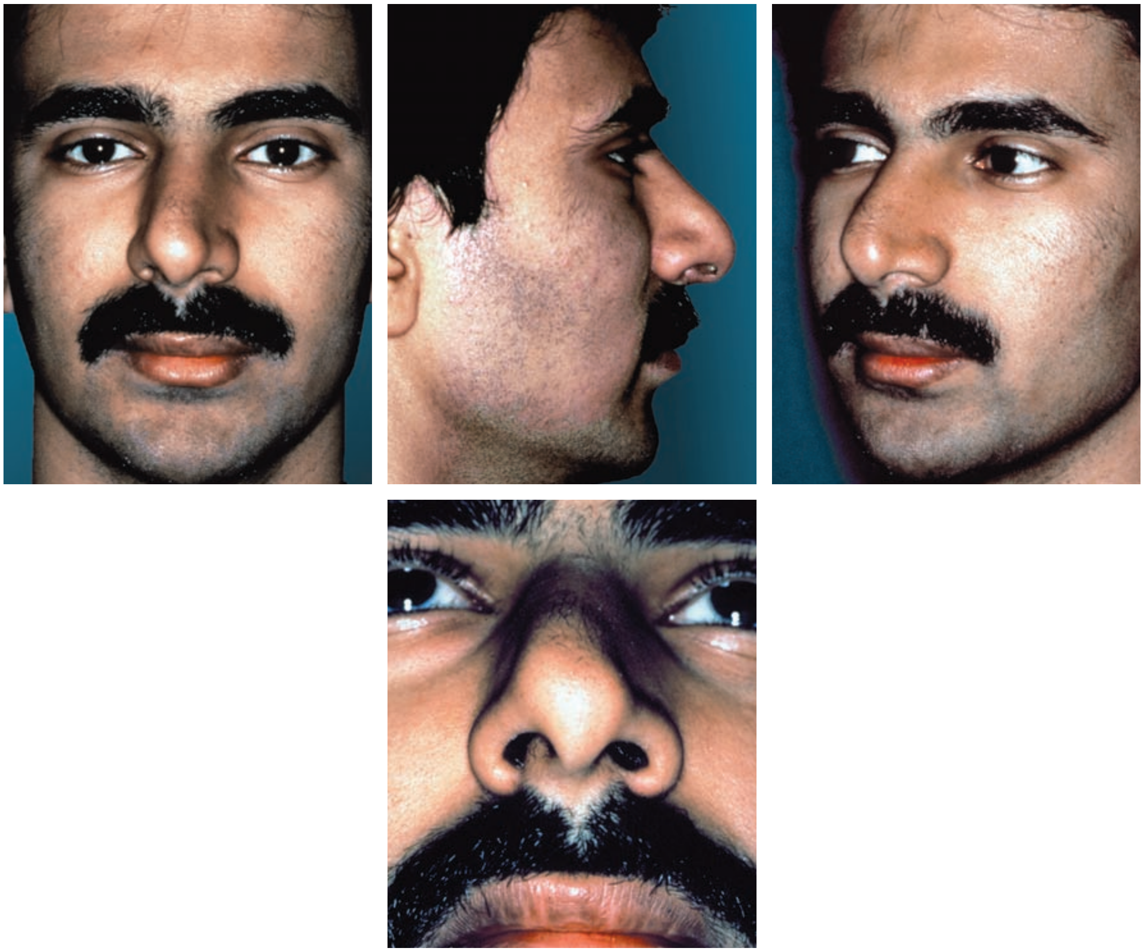
- Correct the pinched tip.
- Decrease the hanging columella and improve the alar-columellar relationship.
- Widen the narrow dorsal aesthetic lines.
- Improve nasal airflow.



Surgical Plan

1. Use an open approach with a transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Harvest septal cartilage.
3. Use bilateral spreader grafts to reconstruct the dorsum.
4. Correct alar collapse with an alar spreader single subdomal bar graft.
5. Perform interdomal and transdomal suturing.
6. Perform a 3 mm resection of caudal septum and overlying mucosa to decrease columellar show.

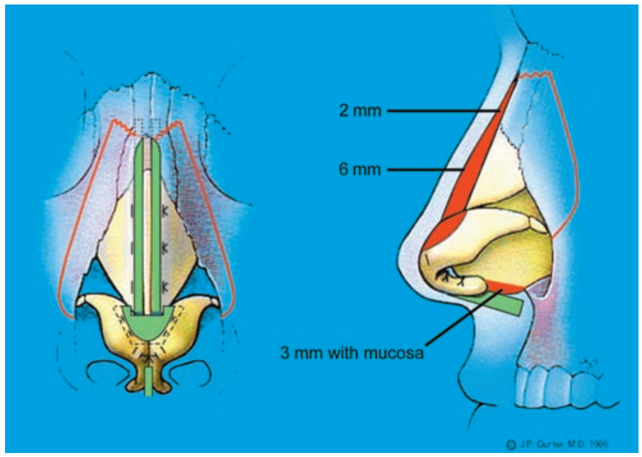
Twenty-three months postoperatively, the tip looks fuller, a smooth gradient extends down to the alar base, and the infratip lobular height is decreased.[3] In the lateral and oblique views, correction of the increased columellar show and the increased infratip lobular height are evident. On the basal view, the nose has a more aesthetic triangular outline with minimal scarring from the transcolumellar incision. The patient has no difficulty breathing through her nose.

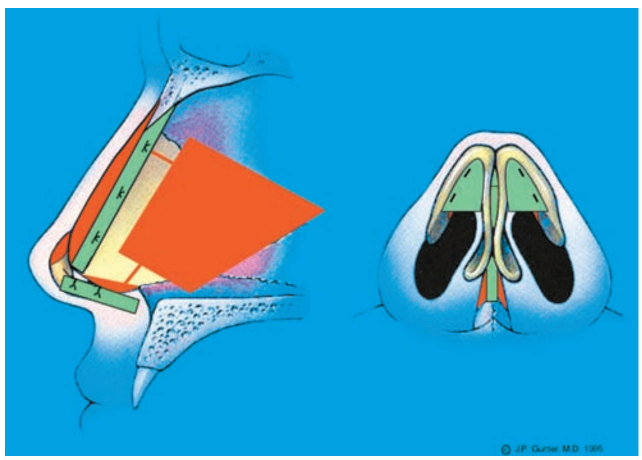


This 24-year-old man's nose had been crooked for as long as he could remember, but he had no breathing difficulties.[3] He had a history of possible trauma as a young child. On the frontal view the nasal dorsum and tip appeared deviated to the right, with collapse of the left upper lateral cartilage. The nasal tip was asymmetrical with obvious collapse of the left alar rim and increased distance between the tip-defining points. The infratip lobular show was slightly exaggerated. The lateral view revealed weak projection of the tip and a supratip fullness. The oblique view substantiated the frontal and lateral findings. On the basal view the caudal septal deviation into the right nostril and collapse of the left upper lateral cartilage were clearly seen, and the left alar rim was concave. The increased distance between the tip-defining points was verified.

The operative goals included the following:

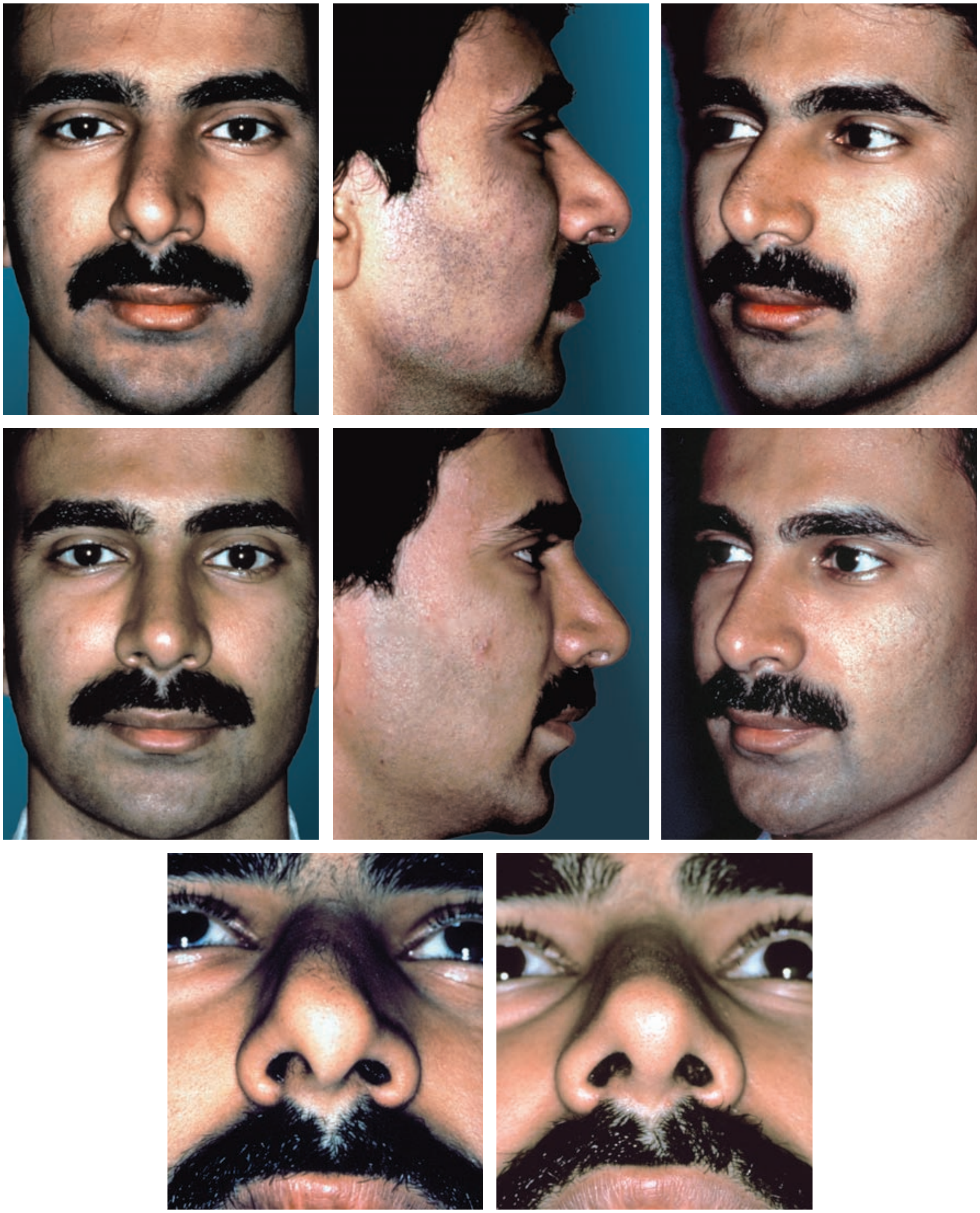
- Correct the nasal deviation.
- Reduce the nasal dorsum.
- Correct the collapse of the left ala.





Surgical Plan

1. Use an open approach with transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Reduce the dorsal hump.
3. Harvest septal cartilage.
4. Reconstruct the dorsum with bilateral spreader grafts.
5. Perform cephalic trim, leaving a 6 mm alar rim strip.
6. Suture an alar spreader triangular graft to the septum to correct alar collapse and increase tip projection.
7. Perform interdomal and transdomal suturing.
8. Resect 7.2 mm of caudal septum and overlying mucosa to decrease infratip and columellar show.



Twelve months after surgery, his nose is straight, the tip symmetrical, and the excessive infratip lobular show improved.[3] The lateral and oblique views show better tip projection and correction of the supratip fullness. On the basal view, the nostrils are symmetrical and the tip has better definition with a decreased distance between the tip-defining points. The left alar rim is no longer concave and the columella does not slant.

KEY POINTS

- A weak lateral crus may result in alar rim collapse.
- Alar rim collapse can be congenital or acquired but most often results from excessive resection of the lateral crus of the lower lateral cartilage during cosmetic rhinoplasty.
- An alar spreader graft technique offers versatility and durability of results after correction of a pinched nasal tip deformity caused by collapsed lateral crura.
- Functionally, alar spreader grafts strengthen the vestibular walls and improve nasal respiration by correcting severely collapsed alar rims and increasing the opening of the internal nasal valves in some situations.
- Aesthetically, alar spreader grafts improve the contour of the alar rim and nasal tip with the use of autologous semirigid tissues that provide long-lasting results.
- In patients in whom the lateral crura have been completely resected or are so distorted that they cannot be used for reconstruction, the crura must be reconstructed.
- In patients with 2 mm or more of lateral crural width, an alar spreader graft can be used to spread the remaining strips of lateral crura laterally to correct the collapse.
- If the graft is too long, the tip will be too broad and the nostrils will flare.
- Alar spreader grafts can help to correct collapsed internal nasal valves.

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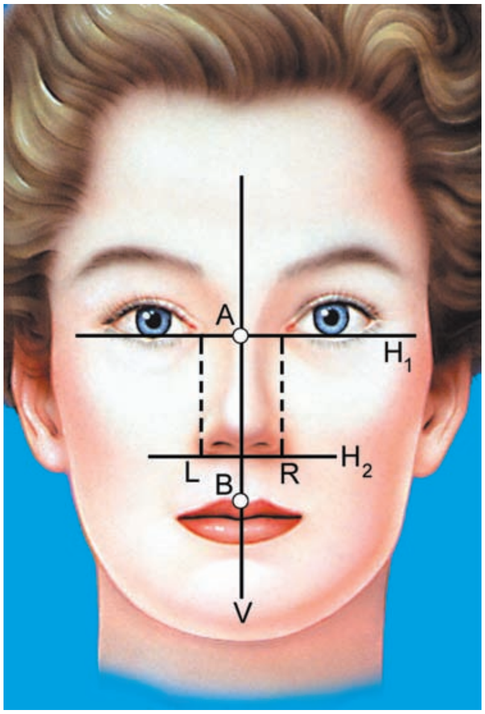
PART SIX

Alar Base



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31

Aesthetics and Surgical Refinement of the Nasal Base

Jamil Ahmad ▪ Rod J. Rohrich ▪ Michael R. Lee

Nasal analysis in rhinoplasty classically includes overall nasal assessment combined with evaluation of specific components. This approach allows surgeons to appreciate nasofacial relationships and recognize subtle features of specific nasal components. This is also true of the nasal base and it should be evaluated in detail to complete nasal analysis.

The anatomy of the nasal base has received less attention in past years than that of the nasal dorsum and tip. The nasal base includes the columellar base, alar lobules, and nostril sills. This anatomy is best appreciated from the basal view. The basal view has been affectionately referred to as “the view for dogs and lovers” but is in fact one of the most revealing and humbling views of the nose, showing asymmetries that are difficult to appreciate in the frontal or lateral view. In addition, deformities including caudal septal deviation, columellar irregularities, nostril asymmetries, and nasal base width are best appreciated from the basal view but remain very challenging to correct.

The basal view has been affectionately referred to as "the view for dogs and lovers" but is in fact one of the most revealing and humbling views of the nose, showing asymmetries that are difficult to appreciate in the frontal or lateral view.

Deformities of the nasal base can be of functional significance in terms of external valve collapse and nasal airway obstruction. Compromise of the nostril aperture by cartilaginous or soft tissue deformity can limit airflow. Restoring the ideal relationships for the columella and alar rims, as well as caudal septal deviation, will improve nasal airflow.

Deformities of the nasal base can be of functional significance in terms of external valve collapse and nasal airway obstruction.

ANATOMY OF THE NASAL BASE

Columellar Base

Columellar base anatomy primarily consists of cartilaginous substructure with soft tissue interposition. Cartilage of the medial crural footplates and interposed soft tissue compose this medial subunit. Such structures are supported by the lower lateral cartilages and caudal septum. These supporting structures both directly and indirectly influence the position and shape of the columellar base.

Malposition or abnormal flaring of these medial crural footplate cartilages can be problematic both aesthetically and functionally. The soft tissue between the medial crus is heterogeneous and consists of collagen fibers and fibroblasts, elastin fibers, adipocytes, and neurovascular structures.[1] Collagen fibers and fibroblasts extend throughout the columella, while sheets of collagen are located at hard tissue abutments such as the caudal septum and medial crura, caudal septum and nasal spine, and medial crura and nasal spine. Muscle fibers contribute the most soft tissue bulk between medial crural cartilages and consist of fibers from the depressor septi nasi and orbicularis oris muscles. Adipocytes contribute in varying degrees to columellar composition. An assembly of adipocytes creates a fat pad anterior to the septum at the medial crura origin. A more generalized dispersion of adipocytes is found throughout the columella. Such cells are interspersed between the muscle and collagen fibers. Elastin fibers are widespread throughout the columella and follow the distribution pattern of collagen fibers. Elastin fibers are in ample volume adjacent to the cartilaginous structures such as the medial crura and are organized in sheetlike form.

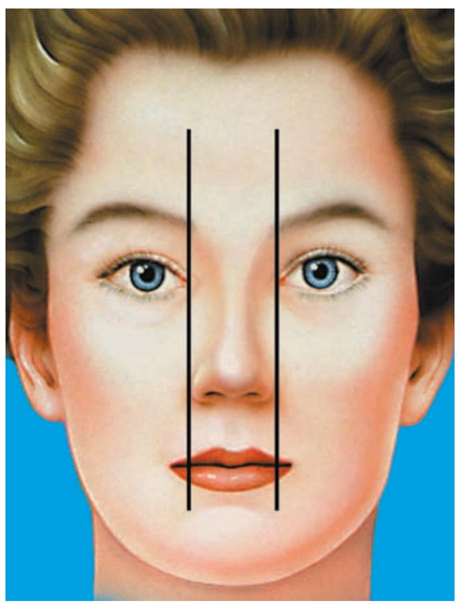
The columellar base is composed of medial crural footplates and adjacent soft tissue including collagen and elastin fibers, muscle fibers of the depressor septi nasi and orbicularis oris, and interspersed adipocytes.

Alar Lobules and Nostril Sills

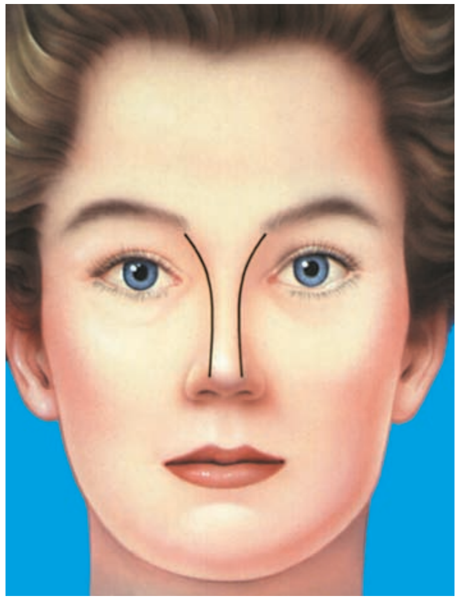
Alar lobules are best described as lateral walls to the nostril and nasal base. The alae are void of cartilage and are composed mostly of fibrofatty soft tissue and muscle. Cephalically, the caudal margin of the lateral crus creates a superior abutment and provides support for the external nasal valve. As the ala continues posteriorly toward the cheek surface, it transforms into the roll-like nostril sill. Medially, the nostril sill ceases at the lateral columellar base.

ANALYSIS AND AESTHETIC IDEALS

Nasal Base



Examining the nasal base as a whole provides information regarding symmetry and nasofacial balance. Analysis of appropriate nasal base width should be in relation to other facial features.

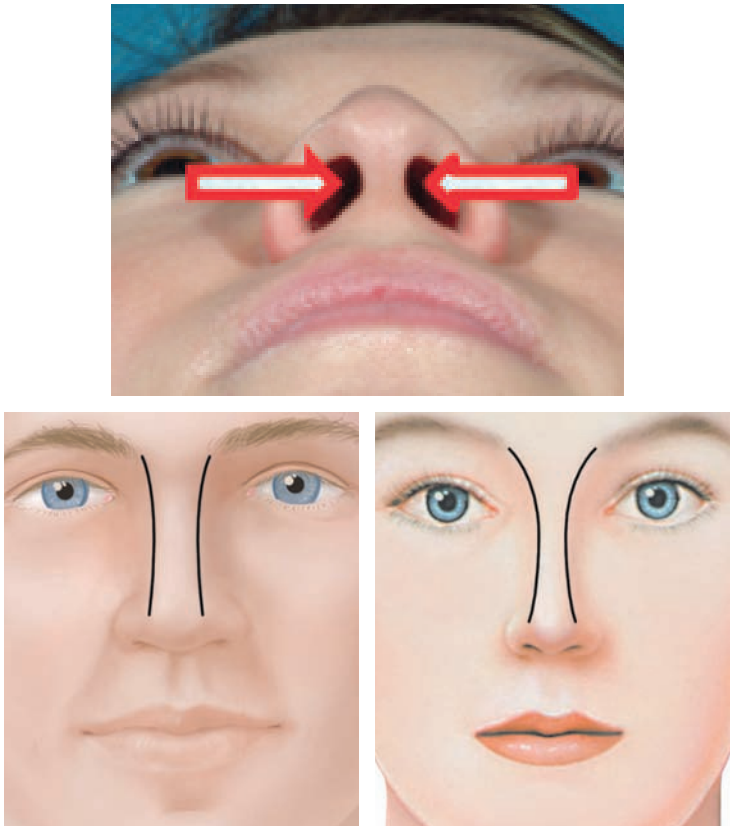


The width of the lower nasal third will determine the appropriate width of the upper nose and guide surgical treatment in achieving nasofacial balance. However, such measurement is only appropriate when the intercanthal distance is ideal in regard to overall facial proportions. If the intercanthal distance is narrow or wide, the base should be judged in relation to the nasal tip, and other facial proportions and relationships will serve as a guide.

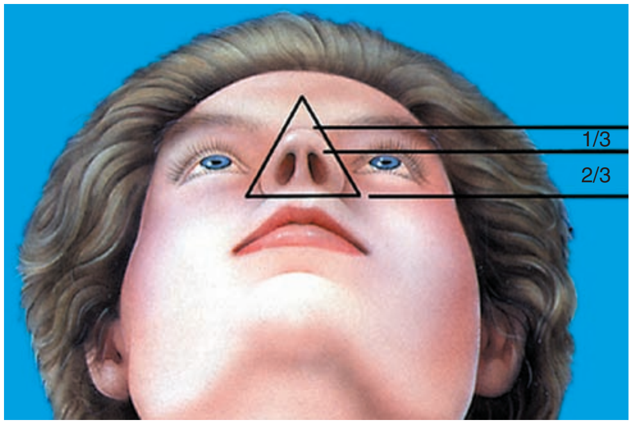
If the intercanthal distance is narrow or wide, the base should be judged in relation to the nasal tip and other facial proportions and relationships will serve as a guide.

Analysis of the nasal base includes evaluation of both the medial and lateral subunits. The lateral subunits comprise the nasal ala and nostril sill. Assessment of the lateral subunit focuses on the shape and size of the lateral nostril as well as the contour of the alar rim. The appearance of the lateral subunits is influenced by the strength and orientation of the lateral crura, along with the soft tissue composing the alar rim. The medial subunit includes the columella, medial crural footplates, and in some cases, the caudal septum. Assessment of the medial subunit includes analysis of the width and position of the columella, including the relationship between the medial crural footplates and the caudal septum. Furthermore, the soft tissue of the columellar base also influences this region and should be evaluated.

Columella and Medial Nostril



The medial nostril is framed by the lateral border of the columella.[2] Because the lateral columellar border is bilateral, symmetry becomes significant in addition to shape and contour. These bilateral borders serve as the transition from the upper lip to the tip lobule. On basilar view they create the basal aesthetic lines, analogous to the dorsal aesthetic lines on frontal view.[2] The basal aesthetic lines are important for nasal harmony and should exhibit a symmetrical, smooth, and slightly concave profile.[2] More proximal the lateral columella should continue a smooth slope ending at the nostril sill. Shape and contour are important, both aesthetically and functionally.



Optimal dimensions of the columella are based on proportional measures. The ideal length of the columella is influenced by the nasal tip lobule. Columellar length should be twice that of the tip lobule, and ideally, the columellar width at the midportion should approximate one third of the columellar width at the nostril base. These ratios lead to a more aesthetically pleasing columella.

The basal aesthetic lines are created by the lateral borders of the columella and are analogous to the dorsal aesthetic lines on frontal view.

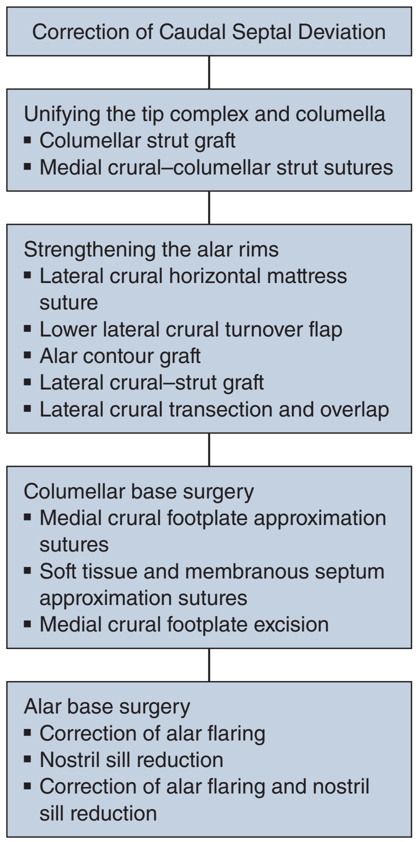
Ala and Lateral Nostril

The ideal nostril possesses a teardrop shape in which the long axis extends from base to apex. There should be a slight medial tilt of the long axis toward the midline as it approaches the tip. The ala serves as the lateral nostril border and should conform to certain ideals. The lateral alar rim should be straight and smooth in contour, whereas the medial aspect should be concave, creating a smooth curvature of the lateral nostril. Such ideals are fulfilled when the lateral crus and fibrofatty soft tissue provide sufficient strength to support alar rim position and shape.

When present, these characteristics of the lateral nostril amalgamate with the ideal lateral columella to produce an aesthetically pleasing nostril. Variation in alar position and shape may be the result of weakened or malpositioned lateral or middle crura. Alar notching or alar retraction tends to compromise rim congruency. Functionally, malpositioned alae can obstruct airflow from either static obstruction or dynamic collapse.

CLASSIFICATION AND MANAGEMENT OF NASAL BASE DEFORMITIES

In most cases, diagnosis and classification of nasal deformities can be made preoperatively and can help to guide management. However, although a deformity may be visible and palpable on preoperative evaluation, intraoperative findings revealing the exact structural cause will also dictate the operative techniques required to correct it.



Management of nasal base deformities can be approached in a sequential manner, as shown in this algorithm.[3]

Columellar strut graft and alar strut grafts

Medial crural footplate approximation sutures

Alar base excisions marked

Alar base excisions performed

Preoperative basal view

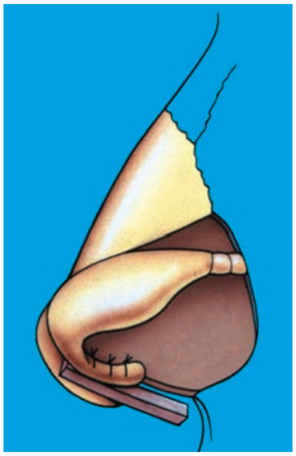
Basal view 2 months postoperatively

This sequential approach will lead to a stepwise, incremental improvement in the aesthetics of the nasal base.

Correction of Caudal Septal Deviation

The anterior nasal septum is one of the major supporting structures of the external nose. Caudal septal deviation may be noticeable through the position of nasal tip as well as the position and shape of the columellar base.[4] Correction of caudal septal deviation is the starting point for improving the nasal base (see Chapter 47).

Unifying the Tip Complex and Columella

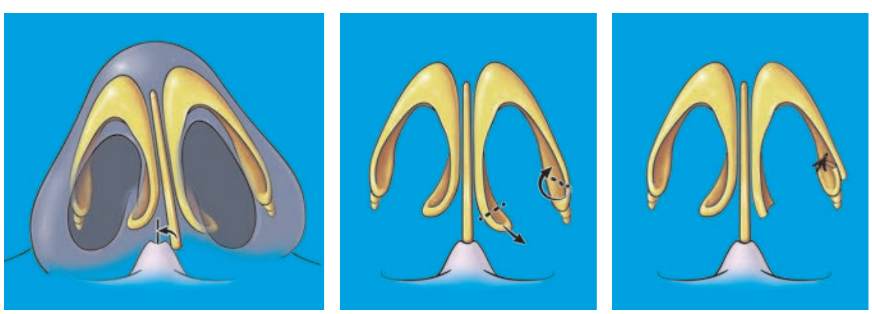


With the open approach, there is tremendous control over shaping of the tip complex. In many instances, a columellar strut graft is required to maintain tip projection and support, unify the tip complex to allow tip refinement, and correct medial crural asymmetries.[5,6] Medial crural strut sutures allow control of both the contour and width of the columella.

Strengthening the Alar Rims

Establishing a smooth, straight alar rim is best accomplished by strengthening the lateral crus through suture techniques, or more commonly by the addition of cartilage in the form of grafts or flaps in both anatomic and nonanatomic positions.

Any convexity of the lateral crus can be improved/reversed with a horizontal mattress suture of 5-0 PDS as described by Gruber et al[7] (see Chapter 18). Equally common is strengthening the lateral crus by using a lower lateral crural turnover flap[8] or lateral crural strut graft[9] in an anatomic position, or using an alar contour graft,[10] lateral crural strut graft, or alar spreader graft[11] in a nonanatomic position. Sometimes a combination of both anatomic and nonanatomic support is applied to strengthen the alae and nasal tip (see Chapters 27 through 30).



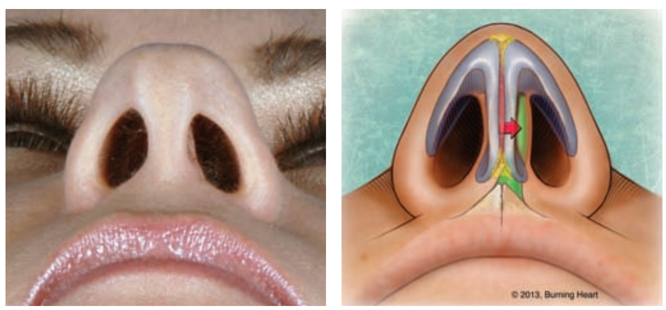
When significant nostril asymmetry is present as a result of asymmetry of the lower lateral cartilages and in particular the lateral crura, transection and overlap of one or both of the lower lateral crura may be required to centralize the tip and create symmetry of the alar rims.[12]

Columellar Base Surgery

Deformities of the columella can be classified as primary or secondary.[2] Primary deformities originate from intrinsic abnormalities, such as the medial crural footplates or adjacent soft tissue. Secondary deformities occur when there is distortion of the columellar base resulting from the influence of structures outside the columella, such as the caudal septum. Diagnosing the cause of columellar deformity primarily relies on inspection and palpation. Surgical exposure confirms the diagnosis and guides surgical treatment.

Classifying columellar deformities is based on aberrations of underlying anatomy.

Type I Deformity



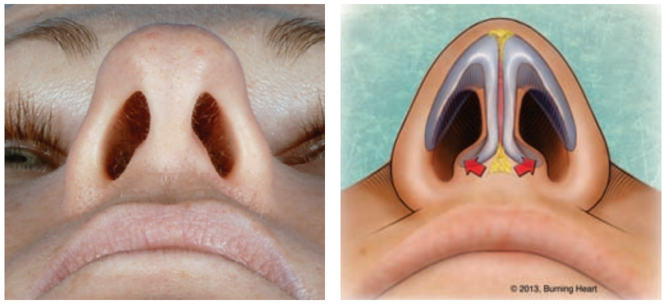
Type I deformities occur when there is columellar distortion related to either the caudal septum or nasal spine.[2] Malposition of the nasal spine is the less frequent cause and by definition is associated with malposition of a seated caudal septum.

Correction of a deviated caudal septum typically requires elimination of the external and internal deforming forces by cartilage scoring or release. Attachment of the caudal septum to the anterior nasal spine may need to be released sharply. This maneuver frees the caudal septum from tension forces that prevent midline approximation and also allows correction of vertical excess of the anterior septum.

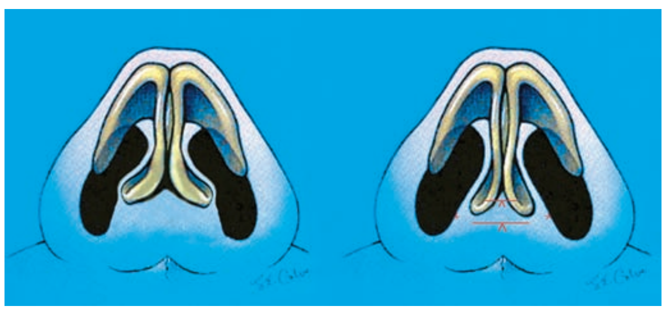
Once the caudal septum is repositioned to the midline, it must be fixed in place. A variety of means to fix the septum in place have been described. A reliable and frequently sufficient method is to use a 5-0 PDS suture to secure the caudal septum to the anterior nasal spine periosteum. Placement of a columellar strut graft also facilitates correcting the position of the columella and the caudal septum may be sutured to the columellar strut.

If the nasal spine is not in the midline, it can be osteotomized and repositioned to the midline. This is rarely needed and should only be performed when more conservative means fail to create a midline caudal septum.

Type II Deformity



Type II deformities are diagnosed when medial crural abnormality is the primary cause.[2] The most frequently identified medial crural irregularity is premature flaring. Such abnormality compromises nostril contour and impinges on the nasal airway. Premature flaring may occur in symmetrical or asymmetrical form and to varying degrees of severity. Lack of footplate flare may also compromise nasal aesthetics, since an overlong, slender columella results.



Asymmetry resulting from excessive medial crural volume is treated with sharp excision of excess tissue. However, the majority of type II deformities can be treated with approximation of the medial crural footplates.[13] Medial crural footplate approximation is used to improve the relationship between the medial crural footplates and the columellar base. A five-step approach is used:

1. The location and extent of splayed footplates are marked by two symmetrical lines that parallel the columella along the inferior medial portion of the nasal sill.
2. An excision is performed of minimal mucosa (1 to 2 mm) overlying the marked area of medial crural footplates.
3. A 5-0 PDS horizontal mattress spanning suture is passed through-and-through the demucosalized skin of the columella, securing the medial crural footplates.

4. A second 4-0 chromic gut horizontal mattress suture can be used to approximate the soft tissue mass at the base of columella and the membranous septum.
5. Mucosal closure is performed with 5-0 chromic gut.

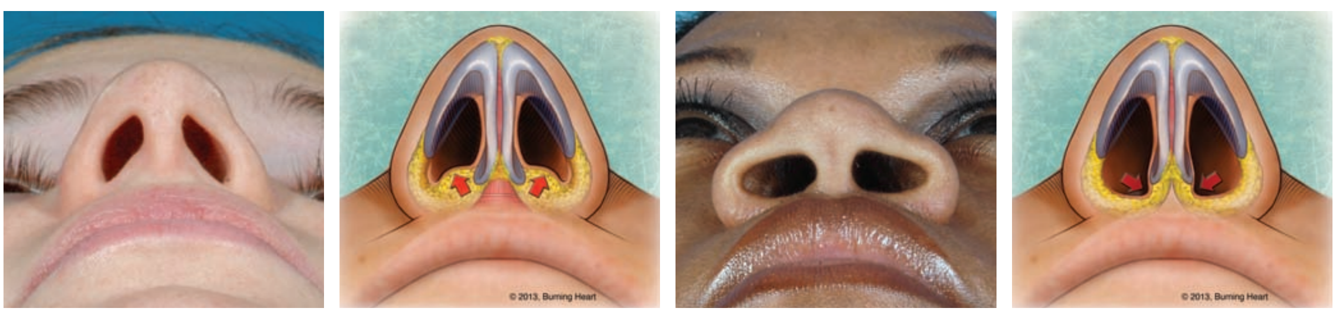
Medial crural footplate approximation can be used to attain aesthetic ideals of the columellar base and improve external valve functionality.

We have adopted this percutaneous technique over previous techniques that required extensive degloving of the columellar base; this method preserves the soft tissue support in the columellar base. Additionally, the protracted edema seen with extensive degloving of the columellar base has not been observed with this percutaneous technique.

The five-step medial crural footplate approximation results in significantly less columellar base edema than other techniques that require extensive degloving.

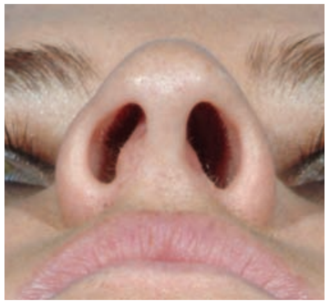
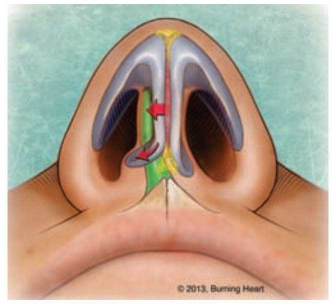
Type III Deformity

Type III deformities are the result of soft tissue volume imbalance. This subset of patients has a deformed columellar base with normal position of the nasal spine, caudal septum, and medial crura. Soft tissue excess or deficiency is the lone causitive factor.



Patients are further classified as Type IIIA (excess soft tissue volume) or Type IIIB (deficient soft tissue volume).[2] Treatment of type IIIA patients requires excision of soft tissue, followed by medial crural footplate approximation. Treatment of type IIIB patients requires the addition of bulk to the columellar base. Such bulk may be accomplished by placing cartilage grafts or performing fat injections.

Type IV Deformity

Type IV deformities are the most common and describe a combined deformity.[2] Abnormalities of the anterior nasal spine, caudal septum, medial crura, and/or soft tissue aberration create this type of deformity. The intimate relationship between these structures is responsible for the common occurrence of this type of deformity. It is important to determine all etiologic factors in the columellar base distortion to ensure adequate treatment. If the footplates are repositioned but the caudal septum remains deviated, the overall aesthetic outcome is hindered. Treatment is customized from the aforementioned methods and specific to the cause.

Medial Crural Footplate Excision

In some instances of medial crural footplate excess, excision of the medial crural footplate is required to achieve the best result. This may be required in an overprojected and/or overrotated nose, or in patients with significant asymmetries of medial crura length for whom excision of the medial crural footplate may be the only way to deal with excessively long cartilages.

Alar Base Surgery

Abnormalities requiring alar base modification include alar flaring, large nostril size, excessive width of the nasal base, and asymmetries of the alae and/or nostrils. Alar base surgery is typically performed toward the end of the operation, since many of these problems are intimately related to tip projection, alar rim contour, and columellar shape. For example, increasing tip projection will result in decreased alar flaring while decreasing tip projection will lead to the opposite effect.

It is important to meticulously plan alar base surgery, especially appropriate planning of the scar so that it is inconspicuous, as well as precise removal of tissue to achieve adequate reduction and symmetry while avoiding overresection.

Alar base surgery is typically performed toward the end of the operation, since many of these problems are intimately related to tip projection, alar rim contour, and columellar shape.

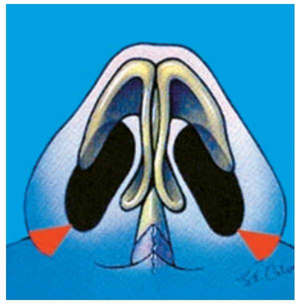
Markings should be made before a local anesthetic is injected, when both the area to be excised and the tissue that will remain can be measured accurately with calipers. Alar base excisions should not be extended superior to the alar groove to avoid damage to the lateral nasal artery and compromise to the nasal tip skin circulation; this is especially true with the open approach, in which the columellar artery has already been divided.[14,15] The surgeon attempts to remove adequate tissue. However, if inadequate reduction is performed, further alar base surgery can be performed quite easily and comfortably under local anesthesia, whereas reconstruction of vestibular stenosis resulting from an overreduced alar base is very challenging and quite often results in unsightly scarring.

Alar base excisions should not be extended superior to the alar groove to avoid damage to the lateral nasal artery and compromise to the nasal tip skin circulation; this is especially true with the open approach.

The scar should not be placed directly in the alar crease but should instead be positioned 1 to 2 mm outside it to avoid disruption and blunting of this natural depression. Closure should be meticulous, ensuring that the transition from external to internal nasal skin at the nostril sill is appropriately lined up. Closure of alar base excisions is typically performed using 6-0 nylon, and these sutures are removed 5 to 7 days postoperatively.

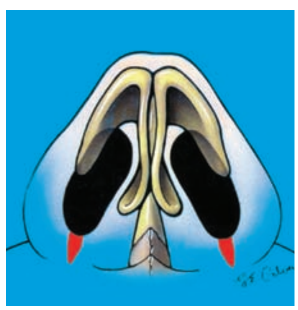
The scar should not be placed directly in the alar crease but should instead be 1 mm outside it to avoid disruption and blunting of this natural depression.

Correction of Alar Flaring



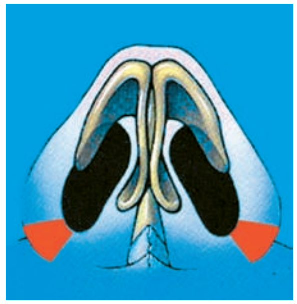
If the patient has alar flaring only and normal nostril size, the flaring is corrected by limiting the excised tissue to the alar flare, leaving at least 1 to 2 mm of the alar base. This prevents alar base notching or blunting of the alar crease. To avoid altering nostril size and/or shape, the incision is not carried into the vestibule. The excised tissue includes the skin and a wedge of deeper tissue, including fibrofatty tissue and alar musculature. The wound is closed with 6-0 nylon using the halving principle, because the alar groove incision is longer than the one on the alar surface.

Nostril Sill Reduction



Nostril sill reduction is a technique that is used to decrease nostril sill length and interalar distance. The nasal incisions have been closed to accurately gauge the amount of resection required. The nostril sill is carefully marked. A No. 15 blade is used to remove a full-thickness portion of the nostril sill. Closure using 6-0 nylon sutures advances the lateral flap medially, thereby decreasing the interalar distance and improving the proportions as seen on basal view. The roll at the nostril sill should be carefully lined up to avoid a visible scar.

Correction of Alar Flaring and Reduction of Nostril Size



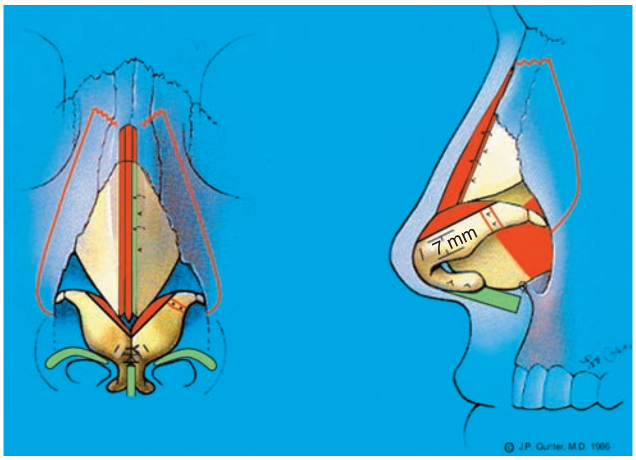
Excising a complete wedge of alar tissue reduces both alar flaring and the nostril circumference. This is done for nostril asymmetry or excessively large nostrils. The posterior incision is again made at least 1 to 2 mm outside the alar crease. At the nostril sill a medially based flap of skin is preserved, and this will help to prevent notching of the nostril. The resection extends into the nasal vestibule 2 mm or more above the nostril sill to reduce the internal circumference of the nostril while preventing redundant tissue at the medial end of the incision. The full-thickness lateral rim is resected superiorly as well and includes fibrofatty tissue and alar musculature. The medially based flap is everted during closure with 6-0 nylon using the halving principle to avoid a depressed scar across the nostril sill.

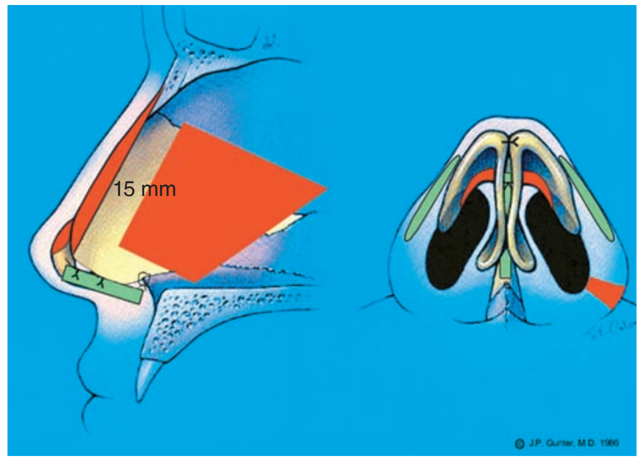
CASE ANALYSES

This 23-year-old woman had significant nasal deviation, a dorsal hump, and an ill-defined tip. In addition, she had bilateral nasal airway obstruction. Nasal analysis confirmed a relative dorsal hump with asymmetrical dorsal aesthetic lines, tip asymmetry, caudal septal deviation, and marked nostril asymmetry.

The operative goals included the following:

- Reduce dorsal hump.
- Correct nasal deviation and restore dorsal aesthetic lines.
- Reconstruct the septum and correct the caudal septal deviation.
- Refine the tip.
- Correct nostril asymmetry.





Surgical Plan

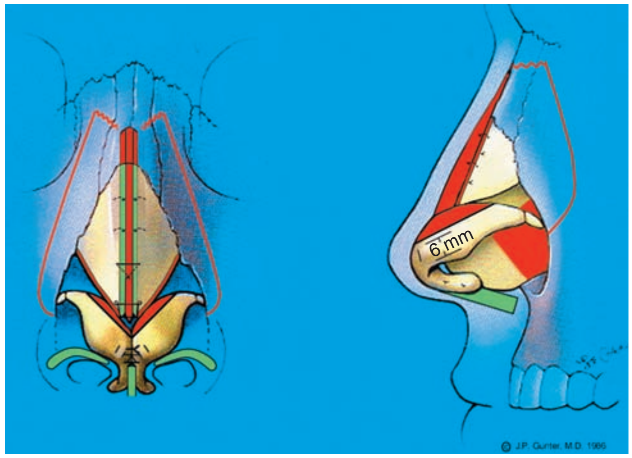
1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform component dorsal hump reduction (4 mm) and create a left auto-spreader flap.
3. Reconstruct the septum and harvest the remaining cartilaginous and bony septum.
4. Place a columellar strut graft with medial crural-strut sutures to unify the tip complex.
5. Perform cephalic trim of the lower lateral cartilages, leaving a 7 mm alar rim strip.
6. Perform transection with a 2 mm overlap of the left lateral crus.
7. Use interdomal and transdomal sutures to refine the tip.
8. Place bilateral alar contour grafts.
9. Perform percutaneous perforated lateral osteotomies.
10. Place a left alar base excision to correct alar flaring and reduce nostril size.

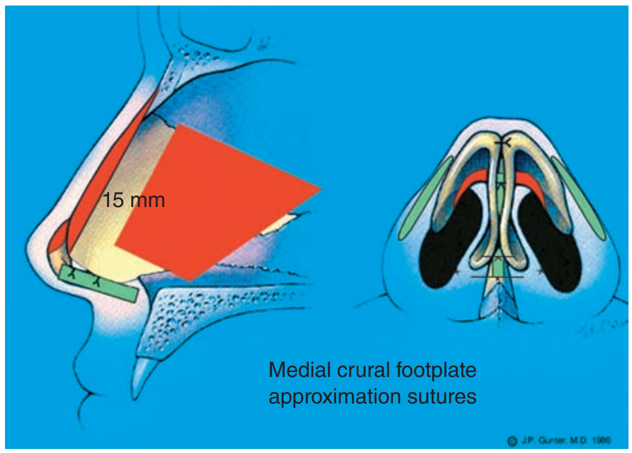
The patient is shown 13 months postoperatively with significant improvement in her nasal deviation, correction of the dorsal hump, and tip refinement. On the basal view, straightening of the caudal septal deviation and restoration of nostril symmetry is best appreciated. Normal bilateral nasal airflow has been restored.

This 30-year-old woman presented with a dorsal hump and an overprojected, boxy nasal tip. She also complained of nasal airway obstruction. In addition, she had microgenia and desired chin augmentation. Frontal view demonstrated asymmetrical dorsal aesthetic lines with widely set tip-defining points. Lateral view reveals a moderate dorsal hump and overprojected, tension tip. Basal view shows the boxy tip clearly and a type II deformity of the columella with flaring of the medial crural footplates.

The operative goals included the following:

- Re-create symmetrical dorsal aesthetic lines.
- Reduce the dorsal hump.
- Decrease tip projection.
- Refine the nasal tip/tip-defining points.
- Correct flaring of the medial crural footplates.
- Perform chin augmentation.





Surgical Plan

1. Use an open approach with a transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Perform component dorsal hump reduction (4 mm).
3. Harvest septal cartilage leaving an L-strut.
4. Perform bilateral submucosal resection of the inferior turbinates.
5. Create bilateral autospreader flaps with upper lateral cartilage tension-spanning suture restoration of the midvault.
6. Perform cephalic trim, leaving a 6 mm alar rim strip.
7. Perform columellar strut graft.
8. Use intercrural, interdomal, and transdomal suturing (5-0 PDS).
9. Perform bilateral alar contour grafts.
10. Perform low-to-low percutaneous perforated lateral osteotomies.
11. Perform medial crural footplate approximation sutures.
12. Perform chin augmentation with a solid silicone implant through a submental incision.

The patient is shown 12 months postoperatively. She has significant improvement in her dorsal aesthetic lines, correction of the dorsal hump, and tip refinement. On the basal view, she has better balance between the nasal base and tip as well as correction of the columellar base deformity. Additionally, normal bilateral nasal airflow has been restored.

KEY POINTS

- The basal view is one of the most revealing and humbling views of the nose, showing asymmetries that are difficult to appreciate in the frontal or lateral view.
- Deformities of the nasal base can be of functional significance in terms of external valve collapse and nasal airway obstruction.
- The columellar base is composed of medial crural footplates and adjacent soft tissue including collagen and elastin fibers, muscle fibers of the depressor septi nasi and orbicularis oris, and interspersed adipocytes.
- If the intercanthal distance is narrow or wide, the base should be judged in relation to the nasal tip and other facial proportions and relationships will serve as a guide.
- The basal aesthetic lines are created by the lateral borders of the columella and are analogous to the dorsal aesthetic lines on frontal view.
- Classifying columellar deformities is based on aberrations of underlying anatomy.
- Medial crural footplate approximation can be used to attain aesthetic ideals of the columellar base and improve external valve functionality.
- The five-step medial crural footplate approximation results in significantly less columellar base edema than other techniques that require extensive degloving.
- Alar base surgery is typically performed toward the end of the operation, since many of these problems are intimately related to tip projection, alar rim contour, and columellar shape.
- Alar base excisions should not be extended superior to the alar groove to avoid damage to the lateral nasal artery and compromise to the nasal tip skin circulation; this is especially true with the open approach.
- The scar should not be placed directly in the alar crease but should instead be 1 mm outside it to avoid disruption and blunting of this natural depression.

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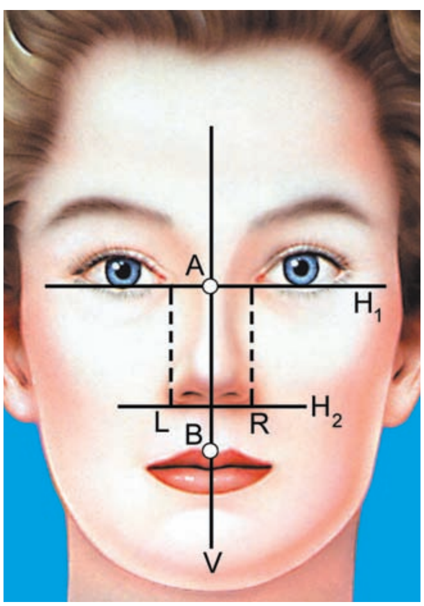
32

Alar Base Surgery

Bahman Guyuron

Failure to correct alar base disharmonies can have prodigious aesthetic and functional consequences. The deformity that results from poor surgical planning during alar base surgery can be difficult and sometimes impossible to correct. It is therefore crucial to prudently evaluate the alar base abnormality and plan the surgical correction with utmost precision.

ANATOMY AND PATHOLOGY



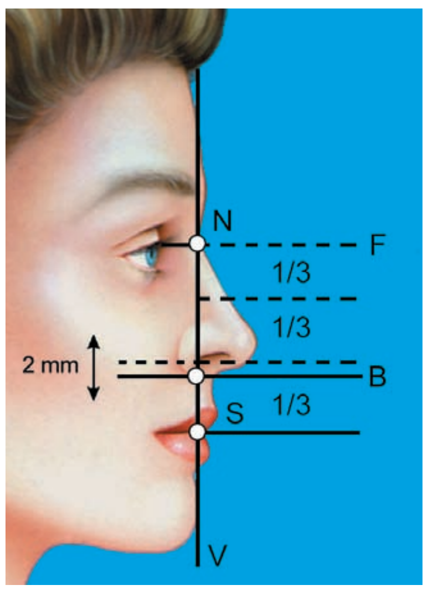
Analysis of alar base position on frontal view

Understanding the relationship of the alar base to other segments of the face and recognition of relevant incongruities are essential to a successful rhinoplasty. On a balanced nose, the distance from one lateral alar base to the opposite one is approximately 2 mm wider than the intercanthal distance in a horizontal plane, as long as the latter is deemed optimal (normally 31 to 33 mm). Should the intercanthal distance be judged abnormal, the orbital fissure (distance from the medial to lateral canthus) can be used as a reference. This distance equals the distance from one medial canthus to the opposite one.

Vertically, the caudal margins of the alar base are approximately 2 mm cephalad to the junction of the middle two thirds and caudal one third of the distance from the medial canthus to the stomion. The intercanthal distance is bisected (point *A*) and a vertical line *(V)* is drawn to pass the philtrum dimple (point *B*) on an otherwise symmetrical face. Two parallel lines (lines *L* and *R*), symmetrically positioned in relation to the vertical midline starting at the medial canthi, should pass 1 mm medial to the outer boundary of the alar base on a congruous alar base relationship in a patient who also has a normal intercanthal distance.

Alar base harmony is judged by comparing the interalar distance to either the intercanthal distance or the orbital fissure width.

The position of the alar base should be assessed and corrected while considering all three dimensions.



Analysis of vertical alar base disharmony
on profile view

The vertical alar base position is readily detected on the profile view. Point *N* (nasion) is connected to point *S* (stomion) and divided into three equal lengths. The caudal border of the alar base is located 2 mm caudal to the junction of the middle and lower thirds.

VARIATIONS IN ALAR BASE DEFORMITIES

Alar base deformities can be horizontal excess or deficiency, and vertical malposition, which is either caudal or cephalad.[1-12] An excess can be the result of a wide alar base, a thick alar base, or a wide nostril sill. A combination of these conditions may also coexist. An alar base deficiency is often more aesthetically consequential and may be traumatic, iatrogenic, or congenital in origin. Some horizontal abnormalities are caused by tip projection or maxillary abnormalities (protrusion/retrusion). *F* is a horizontal line at the level of the medial canthus, and *B* is a horizontal line drawn at the level of the *subnasale* (junction of the columella and the upper lip). Correction of those underlying skeletal anomalies will improve the appearance of the alar base without direct surgery on this site.

Alar base pathology can vary, and successful correction mandates a careful analysis and masterful execution of the surgical plan to achieve a pleasing alar base.

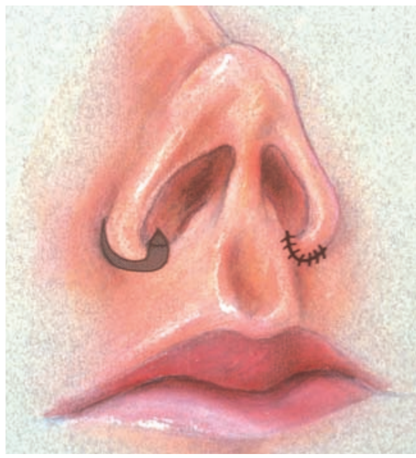
Cephalic malposition of the alar base gives the appearance of a longer nose and results in a more exposed columella. A caudally malpositioned alar base causes hooding of the base, decreased columellar show, and a nose that often appears shorter. Either condition may be unilateral or bilateral.

OPERATIVE TECHNIQUES

The procedure may be conducted under general anesthesia in conjunction with a more extensive rhinoplasty, although minor alar base surgery could be performed with the patient under local anesthesia, with or without intravenous sedation.

Horizontal Deformities

Wide Nostril Sill



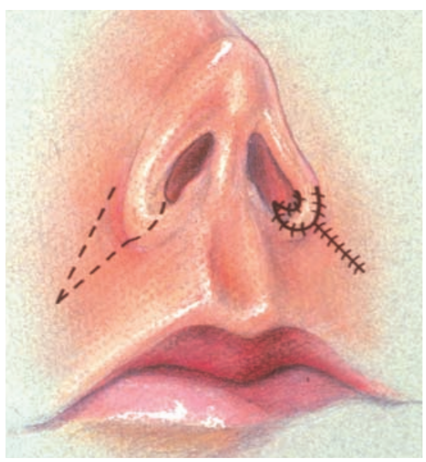
Careful analysis of the alar base may reveal that the nostril sill is wider than ideal. This is the most common abnormality. The excess nostril sill to be excised is marked by two lines almost parallel to each other and connected by a horizontal line placed at the junction of the nostril sill and the upper lip and extended laterally along the alar-facial crease far enough to avoid a dog-ear formation. An incision is made using a No. 15 blade, and the excess nostril sill is excised. Adequate tissue is left laterally to ensure a graceful transition from the alar base to the nostril sill and to avoid an angulation. The incision is continued with a microneedle electrocautery, releasing the soft tissue, including the muscles, to facilitate medial transposition of the alar base flap. The incision is then repaired using 6-0 plain catgut. When a significant transposition is necessary, such as in black patients, a subcutaneous suture is placed using 6-0 Monocryl.

Alar base surgery is planned so that there is a graceful and pleasing transition from the ala to the nostril sill following correction of the disharmony.

Excess Nostril Sill and Wide Alar Base

The excised area includes a combination of nostril sill and alar base in varying proportions, depending on the degree of excess. The technique is similar to the excision of a wide nostril sill, except that the shape of the excised area is more of a wedge. Furthermore, the excised area may be more lateral, and a very small segment is removed from the nostril sill, depending on the alar base configuration.

Thick Alar Base



An L-shaped or crescent excision is made where the anteroposterior limb of the L reduces thickness, and the cephalocaudal excision will narrow the nostril. A mirror image of the incision is made on the opposite nostril. The thickness can also be reduced by removal of the excess soft tissue between the skin and intranasal lining through an incision along the alar rim only.

Combination of Wide Nostril and Thick Alar Base

To simultaneously narrow the nostril and make the alar base thinner, the surgeon may use an inverted-T resection. An incision is made at the alar-facial crease and continued around the base of the nostril. A posteriorly based triangular incision is designed to join the incision that will be used to narrow the alar base. The excess tissue is removed and the margins are reapproximated using 6-0 fast-absorbing plain catgut. This type of excision is seldom necessary.

An inverted-T resection is used to narrow the nostril and thin the alar base simultaneously.

An elliptical excision along the vestibular aspect of the alar base can be used to correct a faceted alar base. The intraoperative view of an elliptically shaped skin excision from a faceted alar base on the left side of the patient's nose is shown above. The right side has been left intact for comparison.

Secondarily Widened Alar Base

Depending on the cause, whether an altered projection or maxillary advancement, the surgeon should use a nostril sill excision, a lateral excision, or both to harmonize the nasal base.

Narrow Nostrils

Constricted nostrils are either secondary to maxillary retrusion or excess tip projection and are rarely encountered. Reducing the nasal base projection can usually reverse the condition. If the problem is maxillary retrusion, a LeFort-type maxillary advancement will resolve the alar base problem. Iatrogenic narrow nostrils can be corrected by transposition of a subcutaneous-based skin flap from the lateral alar base to the medial base, or by an alar base spreader graft.

Vertical Deformities

Cephalically Malpositioned Alar Base

If the alar base is wide as well as cephalically malpositioned, narrowing the alar base results in medial and caudal translocation of the base. Otherwise, removal of an elliptical-shaped area of skin from the upper lip at the junction of the alar base and the lip is planned. The incision is made in the alar-facial crease and continued around the base to the nostril sill. The size of the resected skin is determined by preoperative facial analysis. It is essential to completely release the soft tissues, including the muscles, in the alar thickness so that the alar base can be advanced. Otherwise, this procedure may result in elevation of the upper lip rather than the alar base being transposed caudally.

If the soft tissue in the alar thickness is not completely released, the upper lip may be elevated instead of the alar base being caudally transposed.

Caudally Malpositioned Alar Base

A caudally malpositioned alar base is less common and more difficult to correct. An incision is made in the vestibular lining just above the alar rim, and a strip of the lining is resected and repaired to reposition the alar base.

ALAR BASE DYNAMICS

The most significant dynamic changes occur in the alar base when the overprojected caudal nose is altered. When the overprojection is reduced, the extra soft tissue will extend caudally and laterally, thus necessitating a maneuver to narrow the base. Conversely, a wide alar base will be automatically corrected if caudal nasal projection is increased. The alar base is widened by maxillary advancement and narrowed by retraction of the maxilla. Lengthening the maxilla will transpose the alar base caudally and reduce the distance between the alar bases. Intrusion of the maxilla will result in cephalic displacement and widen the alar base.

When an overprojected caudal nose is reduced, the extra soft tissue will extend caudally and laterally widening the alar base and necessitating a maneuver to narrow the base.

■ ■ ■

Narrowing the alar base will result in caudal transposition of the alar rim.

Narrowing the alar base also affects other facets of nasal base appearance. The alar rim is repositioned caudally, which reduces the columellar-alar vertical discrepancy. In most patients this improves nasal aesthetics; however, it will be detrimental to the nasal balance in patients with a caudally positioned alar rim or a retracted columella.

Narrowing the alar base will be detrimental to the nasal balance in patients with a retracted columella or a caudally positioned alar rim.

Before any alar base resection, the columellar base must be adjusted if necessary. Excess footplate divergence may ostensibly render the nostrils narrow, and repositioning the footplates may unveil the alar base excess. If an alar rim graft is intended, it is placed before alteration of the alar base.

Before any alar base resection, alar rim grafts should be placed, and the columellar base must be adjusted if necessary.

KEY POINTS

- Alar base harmony is judged by comparing the interalar distance to either the intercanthal distance or the orbital fissure width.
- The position of the alar base should be assessed and corrected while considering all three dimensions.
- Alar base pathology can vary, and successful correction mandates a careful analysis and masterful execution of the surgical plan to achieve a pleasing alar base.
- Alar base surgery is planned so that there is a graceful and pleasing transition from the ala to the nostril sill following correction of the disharmony.
- An inverted-T resection is used to narrow the nostril and thin the alar base simultaneously.
- If the soft tissue in the alar thickness is not completely released, the upper lip may be elevated instead of the alar base being caudally transposed.
- When an overprojected caudal nose is reduced, the extra soft tissue will extend caudally and laterally widening the alar base and necessitating a maneuver to narrow the base.
- Narrowing the alar base will result in caudal transposition of the alar rim.
- Narrowing the alar base will be detrimental to the nasal balance in patients with a retracted columella or a caudally positioned alar rim.
- Before any alar base resection, alar rim grafts should be placed, and the columella base must be adjusted if necessary.

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Nasal Base Reduction

Ronald P. Gruber ▪ Nirmal Nathan ▪ Ryan D. Endress

The nasal base composes only a single part of the nose, but an extremely important one. Ideally, a patient should have a normal nasal base relative to the rest of the nose and the face. There is no consensus, however, regarding the amount of resection that should be undertaken to achieve this goal. Consequently, one of the worst problems that occurs after overaggressive alar base excision is a small, out of proportion ala with nostril stenosis.

In this chapter we will classify the anatomy, provide a rationale for finding those components of the nose responsible for the abnormal width, suggest a practical means of alar base resection and overall nasal base reduction by alar release (with interalar sutures), and provide a few caveats to help the surgeon avoid commonly seen stigmata from indiscriminate alar base excision procedures.

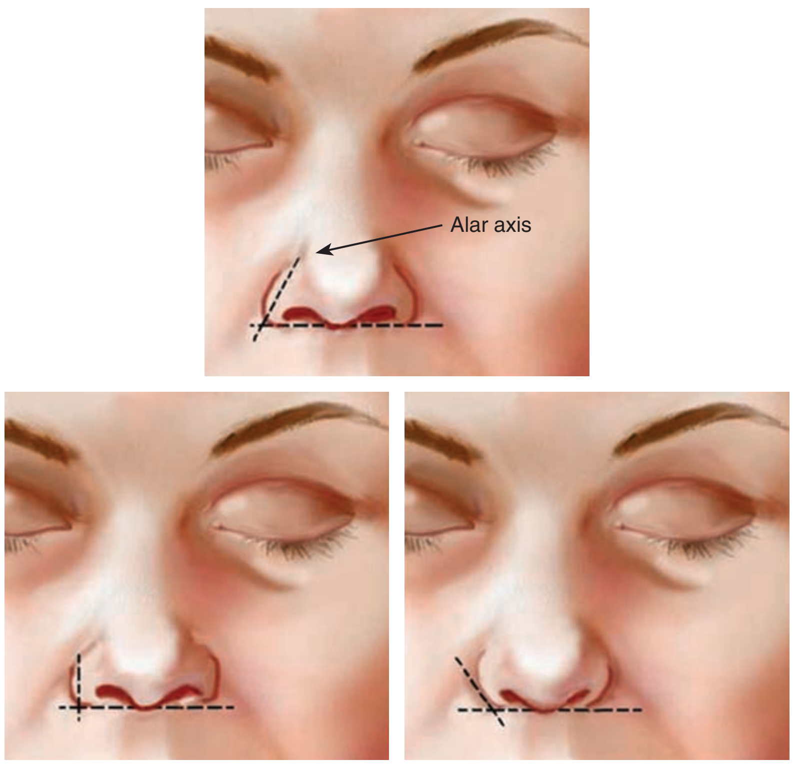
BACKGROUND

The technique of alar base surgery has been modified and perfected by many surgeons.[1-20] The technique we are using and demonstrating has been chosen from this evolutionary body of work. Our emphasis is on a more neglected component of nasal base reduction, often referred to as the *cinch procedure,* that has been developed and pioneered by a number of surgeons over the years.[21-31] We will demonstrate some minor modifications to that procedure and provide a plan that incorporates it into an algorithm to reduce the overall nasal base width.

INDICATIONS AND CONTRAINDICATIONS

The indications for nasal base reduction are when the frontal view reveals that the interalar distance is significantly larger than the intercanthal distance. This rule is somewhat flexible in that a number of faces are either very long, very wide, or have unusually wide or narrow intercanthal distances. Morphing the nose with a computer imaging program to find the ideal width relative to the rest of the face can be very helpful in discussions with the patient and in planning the appropriate procedure.

There are a number of component procedures used to reduce the nasal base. All of them are potentially contraindicated if the individual component is in fact normal but an attempt is made to resect it to reduce the overall nasal base width. One of the typical problems that occurred in past years was radical alar base resection to achieve nasal base narrowing.

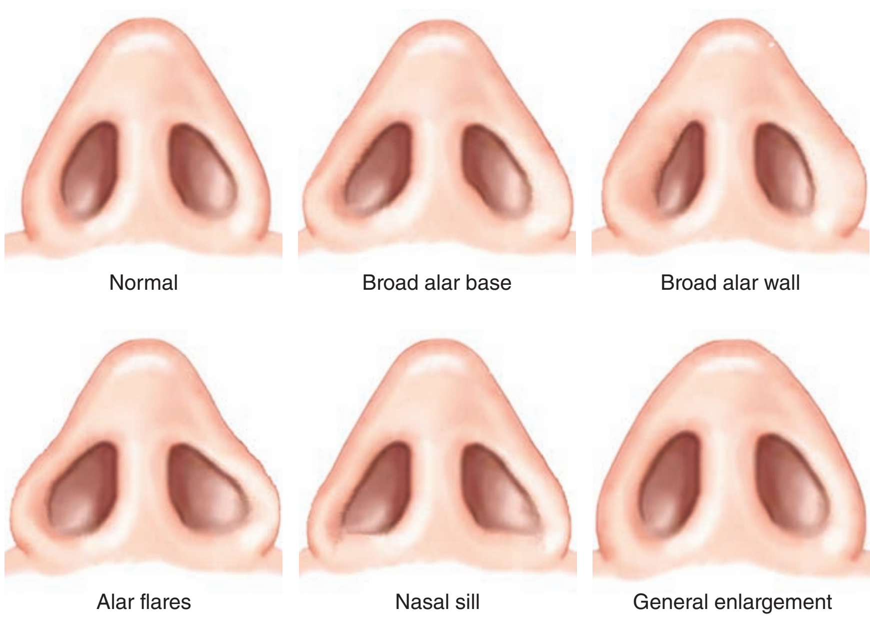


One potential contraindication for certain nasal base surgeries is the patient who has a *parenthesis deformity.* One can diagnose this condition by drawing tangential lines at the maximum curvature of the alae. Normally the two axes diverge downward and outward. In parenthesis alae deformities the axes are parallel to one another; hence the term parenthesis. If the axes aim inward and downward, the nose tends to take on the appearance of a *bowling pin deformity.*

When a prior alar resection has been overaggressive, the inferior aspect of the ala may be pulled in such a way that the alae now appear to be two parentheses. Further resection of the alar base may easily aggravate this condition, thus causing the bowling pin deformity.

PREOPERATIVE ASSESSMENT AND PLANNING

Preoperative Assessment



Normally the nose has an equilateral triangular shape on basal view. A broad nasal base becomes apparent as it alters the shape of that triangle. However, there are actually a number of components and conditions of the nose (as seen on basal view) that can give rise to broadening.

Classification for Preoperative Assessment

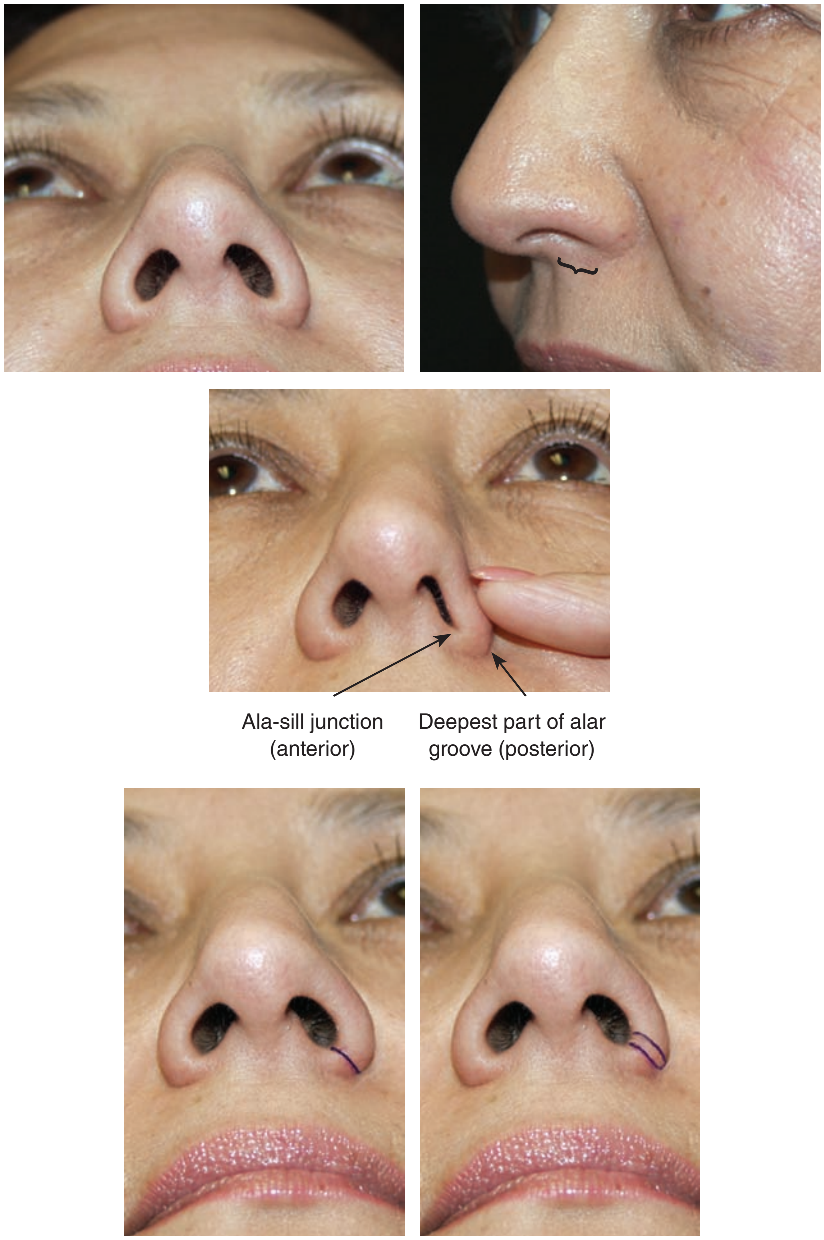
I. Ala
   Broad alar base
   Broad alar wall
   Alar flare
II. Nasal sill
III. Columellar base (containing the footplates)
IV. General enlargement
   Obvious after other excisional procedures have been done and the nasal base is still broad

The nasal base width is usually equivalent to the distance between the medial canthi.

Rhinoplasty techniques potentially involve correcting any of the component problems listed. The surgeon must realize that general enlargement is frequently a problem but is not always recognized. It is often a component that when reduced can accomplish what alar base excision alone cannot do.

Alar scars from alar base excision are minimized by keeping the incision directly in the junction between ala and sill.

Planning for Alar Base–Sill Excision

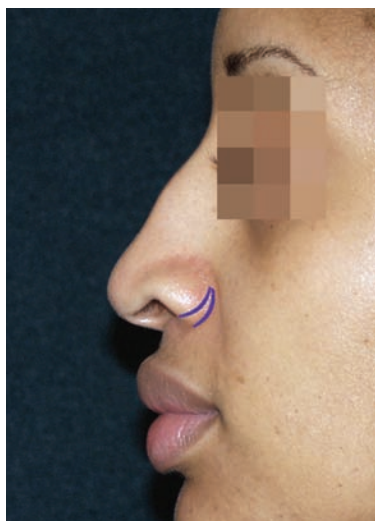


The junction of the ala with the sill (which is noticeable in most noses) is made by pushing the ala medially with a finger when the ala is not very obvious. It tends to fold on the sill because the sill is usually not in the same plane as the ala but instead tends to aim in a forward (anterior) direction. In other words, the sill usually extends in an anterior-posterior direction as well as a side-to-side direction.

The alar-sill junction is identified by pushing the ala medially and noticing the fold that develops between ala and sill.

The amount of ala or sill to be removed is estimated and marked. The marking does not go beyond the lateral extent of the ala (beyond the deepest part of the alar groove) unless the patient has strong alar flare. This is done to avoid a scar on the lateral aspect of the ala, which would be more noticeable than on the anterior aspect of the ala.

In performing alar base excision, the surgeon should avoid the lateral aspect of the ala, because the scar may show. This may be unavoidable in a patient with severe alar flare.



If flare must be treated, the resection involves the lateral ala and is marked from the profile/lateral position.

Planning for Alar Release With Interalar Suturing

Medialization of the ala following alar release has a potentially very dramatic effect on nasal rotation. This can be tested for preoperatively with the alar pinch test. The examiner's index fingers are placed on either side of the alae, which are pushed medially to see what effect it has on nasal tip rotation. In a nose with an acute nasolabial angle, this can be a benefit. In a nose that has an upturned tip, this can be a deficit, and the surgeon must plan how to derotate the nose following alar release with interalar sutures.

The pinch test warns of possible tip overrotation that might occur following alar release and medialization.

OPERATIVE TECHNIQUE

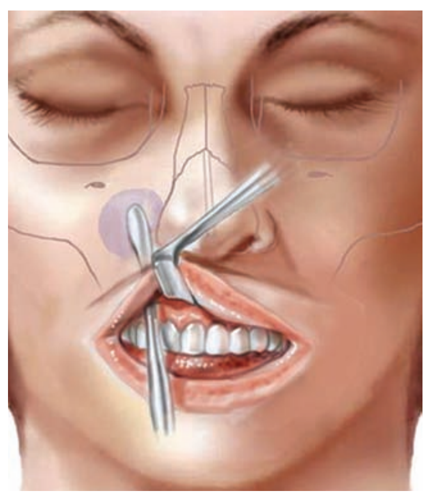
Alar Base–Sill Excision

1. Grasp the alar or sill segment to be resected with Adson-Brown forceps.
2. When the nostril is large, extend the alar or sill excision into the vestibule.
3. Incise just into the subcutaneous fat and not beyond to avoid unnecessarily transecting vessels.
4. Repair deep tissues with 4-0 Dexon or Vicryl unless interalar sutures are planned.
5. Close the skin with interrupted 5-0 nylon.

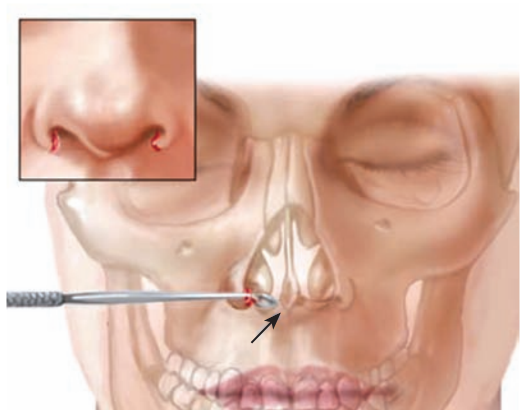
Alar base excision is not the only way to reduce the overall nasal base width.

Alar Release and Interalar Suturing

1. If the alar excision has been completed, spread the opening with scissors to expose the deep portion of the alar wound. Muscles of the ala are commonly seen.
2. If no alar excision is planned, place the incision at the alar-sill junction and spread the wound with scissors to expose the deep subcutaneous tissues.



3. Make a small incision in the buccal sulcus at the level of the ala. Insert a Joseph periosteal elevator and sweep the tissues (periosteum) off the maxilla and off the lateral rim of the piriform fossa.



4. Sweep the tissues (periosteum) off the inferior rim of piriform fossa until resistance is met. If further alar release is needed, a septal knife is used to release ligamentous structures[31,32] from the inferior rim of piriform fossa *(arrow)*.
5. Using a 2-0 nylon with a large (approximately 3 cm long) needle, take a purchase of the deep tissues of the alar wound. The surgical bite will usually be in muscle.
6. Pass the needle from one alar wound to the other and pick up the deep soft tissues of the contralateral side.
7. Pass the needle back to the original starting point.
8. As the knot is tied, it is best to overcorrect slightly. Check the adequacy of the resultant width of the nasal base by placing the handle of a forceps in each nostril and spreading laterally to test the nasal base width under tension. Do not hesitate to redo the suture if you are not satisfied with the resultant nasal base width under tension. Examine the adequacy of the nasal base width from the head of the bed as a final check.

9. One can either use a single 2-0 nylon suture or two 3-0 nylon sutures. If the latter is chosen, it is best to put the knot of each suture in a different alar wound.
10. Close the alar skin wounds with 5-0 nylon interrupted sutures.

Overall nasal base reduction is done by releasing the ala from its maxillary and piriform attachment and securing it with interalar sutures to the contralateral side.

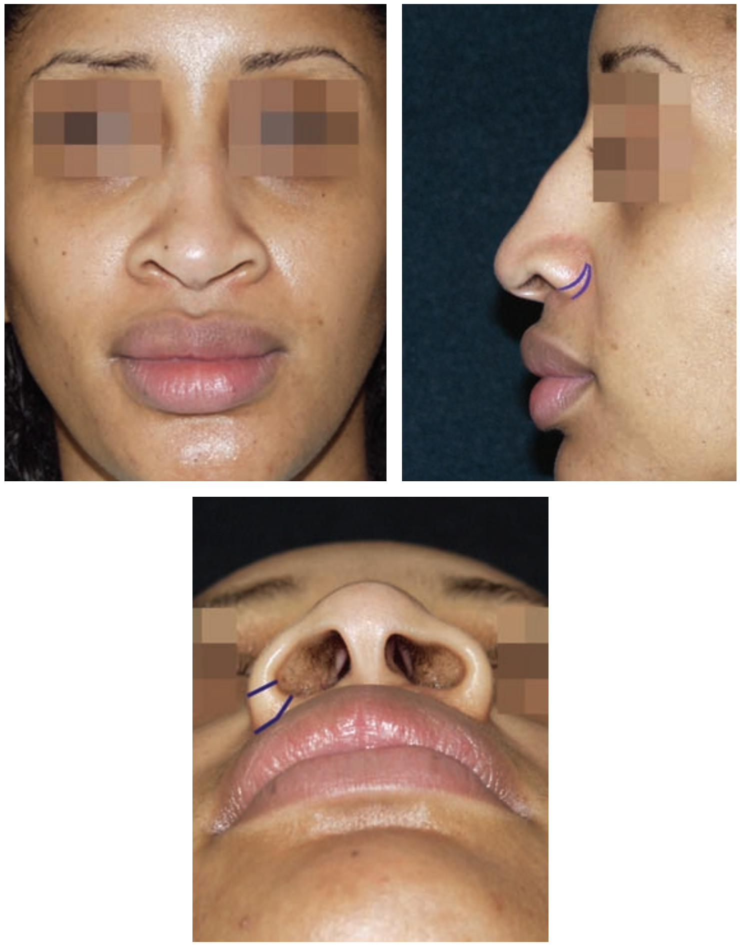
CASE ANALYSES

This 32-year-old woman presented with a broad middle third of her nose, very thick skin, a broad nasal base (extending beyond the medial canthi), a broad nasal tip, and normal to slightly enlarged nostrils. The columellar base was slightly broad, with a slight tendency of the alae to flare.

Surgical Plan

1. Use an open approach.
2. Excise the alar base, with minimal extension into the vestibule.
3. Perform tip-plasty with sutures.
4. Perform cephalic resection of the lateral cura.
5. Resect the medial portion of the upper lateral cartilages, leaving enough for a functional internal valve.

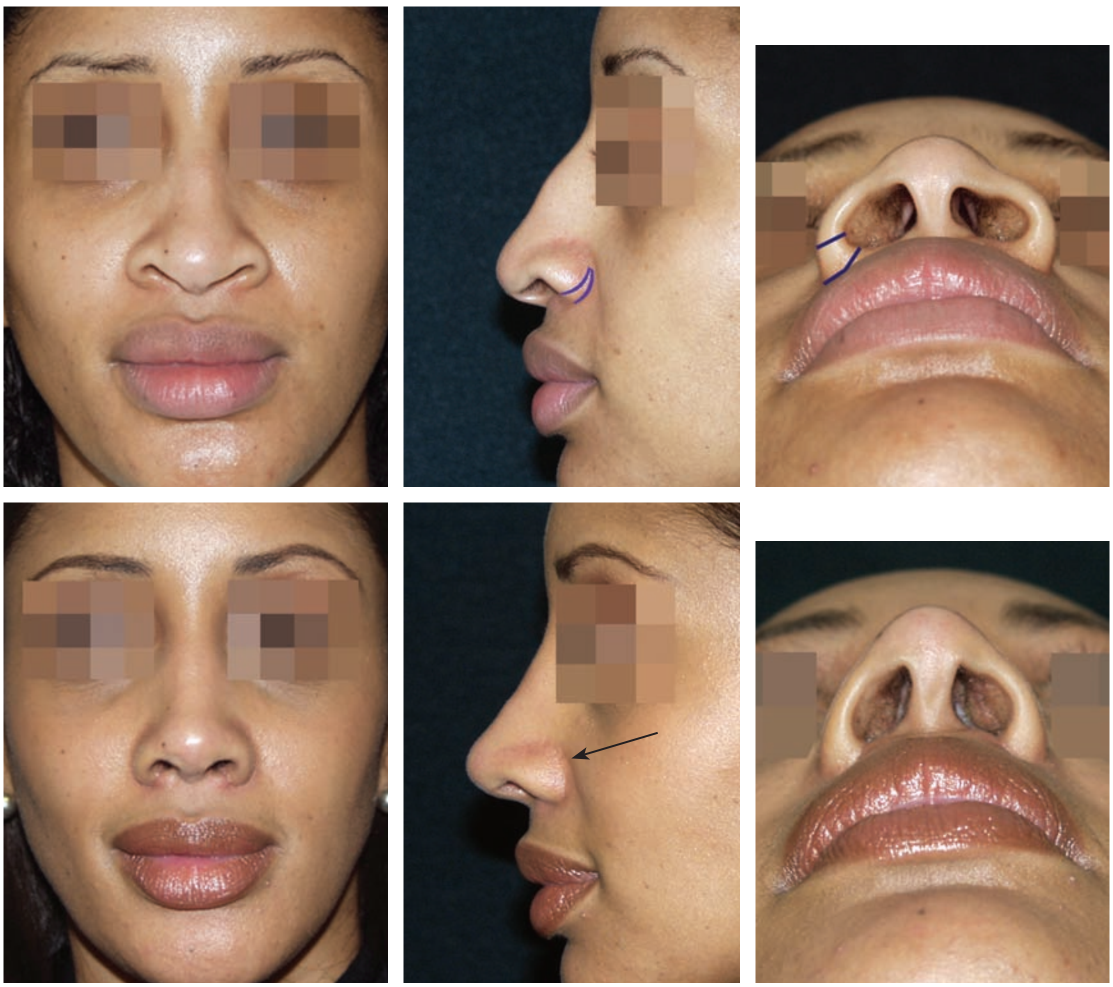
The result at 11 months postoperatively shows improvement in the alar base width and consequently the overall nasal base width of which it is a part. The nostril perimeter is not abnormally small. The nasal tip and middle third of the nose are improved in overall width. However, there is some notching of the apex of each nostril.



This 34-year-old black woman presented with flared nostrils, a wide infratip lobule on frontal view, but a vertically short infratip lobule on basal view, a very broad overall nasal base width, alar notching as seen on lateral view, large nostrils, a dorsal hump, and a slightly long nose.

Surgical Plan

1. Use an open approach.
2. Excise the alar base, extending laterally and into the nostrils.
3. Place alar contour rim grafts.
4. Perform septal shortening.
5. Reduce dorsal hump and perform spreader flaps.
6. Perform a suture tip-plasty.
7. Position a tip graft.



Thirteen months postoperatively there is improvement in the patient's overall nasal base width. The size of her nostrils is much better, although perhaps these could have been made slightly smaller. The profile is much improved.

This 37-year-old Filipino woman presented with a broad nose and medium-thick skin. In particular, the nasal base was broad, although the nostrils were an appropriate size.

Surgical Plan

1. Use an open approach.
2. Perform suture tip-plasty and tip graft from septal cartilage.
3. Perform lateral osteotomies.
4. Used diced ear cartilage in temporal fascia for dorsal augmentation.
5. Make alar base excisions.
6. Perform alar release with interalar suturing.

At 11 months postoperatively the overall width of the patient's nose is improved. The alar base excision did not compromise the nostril diameter. Her nose looks slightly taller because of the dorsal augmentation. The nasal base reduction (alar release and interalar sutures) did the most to improve the aesthetics of her nose. The alae are hanging slightly on lateral view and could use improvement.

This 26-year-old woman had a very broad nasal base and thick skin, especially the alar wall. There was no actual sill, as occurs occasionally in the human population. She also had dorsal deficiency.

At the first surgery the operative goals included the following:

- Use a closed approach (to minimize scar deposition).
- Debulk the alar wall.
- Perform a small alar base resection.
- Augment the dorsum.

Some improvement was achieved in reducing the nasal base width, but a larger than normal infratip lobule resulted from the procedure. The patient desired a narrower nose, but it was recognized that further soft tissue resection would only create distortion and/or nostril stenosis. Therefore a second surgery was performed over a year later.

Surgical Plan

1. Use a closed approach.
2. Perform extensive alar release through a buccal sulcus approach.
3. Apply a pair of 3-0 nylon interalar sutures.

Photos taken 14 months after the second procedure reveal that the patient's nasal base is narrower. Although the skin is still thick and the infratip lobule is still large, the alar wall thickness is in keeping with the thickness of the skin elsewhere in the nose. However, the overall appearance of the nose is improved because the nasal base was reduced to fit the rest of the nose. In hindsight, alar release and interalar sutures could probably have been done at the first procedure.

This 46-year-old woman had large, flaring nostrils, thin- to medium-thick skin, a slight tip deficiency, and slight alar retraction.

The operative goals included the following:

- Use an open approach.
- Place alar contour rim grafts.
- Perform wide alar resection extending laterally to correct flare.
- Perform suture tip-plasty.
- Place a tip graft.

At 11 months postoperatively improvement was evident. The tip and infratip lobule appeared more normal, and the slightly concave rim was improved. The nostrils were smaller in size and there was less flare. However, the overall nasal base was still slightly wide, and there were parenthesis alae. Therefore a second procedure (approximately 1 year later) was performed with care exercised to avoid exacerbating the parenthesis alae and causing a "bowling pin" deformity.

Surgical Plan

1. Use a closed approach.
2. Perform extensive alar release through a buccal sulcus approach.
3. Apply a pair of 3-0 nylon interalar sutures.

At 17 months postoperatively the nasal base is narrower. There has been no improvement to the parenthesis alae, but a bowling pin deformity was not created. In hindsight one could easily argue that alar base release with interalar sutures should have been considered at the time of the first procedure.

COMPLICATIONS

Complications from alar base excision commonly involve overresection. Nostril stenosis may result and the alar walls become straight and short. The overall shrinkage of nostril and ala may then become totally out of proportion to the rest of the nose. Another major complication is the appearance of the alar base scar. If the scar is located on the lateral aspect of the ala (as sometimes has to be done with large flaring alae), the scar can be quite visible in the lateral view. Therefore a conservative resection laterally is strongly recommended and reserved for significant alar flare cases.

Complications from overall nasal base reduction (involving alar release, medialization, and interalar sutures) typically include recurrence. Even when the tension is eased by piriform ligamentous release, and even when strong permanent sutures are used, some recurrence is not uncommon. Over time, when the patient smiles repeatedly, the alae are stretched laterally. The ultimate solution for reducing this potential complication further has yet to be developed.

CONCLUSION

Creating or maintaining a normal nasal base width is important for the overall aesthetics of the nose. Aggressive alar base excision to achieve that goal often results in distortion and abnormal anatomy. The nasal base should be analyzed in terms of its components (ala, sill, and columellar base). Preoperative analysis is essential to determine which components, if any, require reduction. The scar from alar base excision can be minimized by (1) not continuing it laterally unless this is absolutely necessary, (2) hiding the incision in the alar-sill crease, and (3) finding that crease by pushing the ala medially up against the sill.

Ligaments at the inferior piriform fossa may prevent medialization of the ala and may need to be released to allow alar repositioning without tension.

In some cases there is no specifically wide component, and an overall nasal base reduction is required. To achieve that overall reduction involves an alar release from the maxilla and piriform fossa, medialization of the alae without tension, and a strong single or double interalar suture (often called a *cinch* procedure). The biggest potential problem is recurrence of the nasal base width. Despite that potential complication, overall nasal base reduction produces one of the most aesthetic, dramatic, and natural corrections of the nasal base of any procedure known.

KEY POINTS

- The nasal base width is usually equivalent to the distance between the medial canthi.
- Alar scars from alar base excision are minimized by keeping the incision directly in the junction between ala and sill.
- The alar-sill junction is identified by pushing the ala medially and noticing the fold that develops between ala and sill.
- In performing alar base excision, the surgeon should avoid the lateral aspect of the ala, because the scar may show. This may be unavoidable in a patient with severe alar flare.
- The pinch test warns of possible tip overrotation that might occur following alar release and medialization.
- Alar base excision is not the only way to reduce the overall nasal base width.
- Overall nasal base reduction is done by releasing the ala from its maxillary and piriform attachment and securing it with interalar sutures to the contralateral side.
- Ligaments at the inferior piriform fossa may prevent medialization of the ala and may need to be released to allow alar repositioning without tension.

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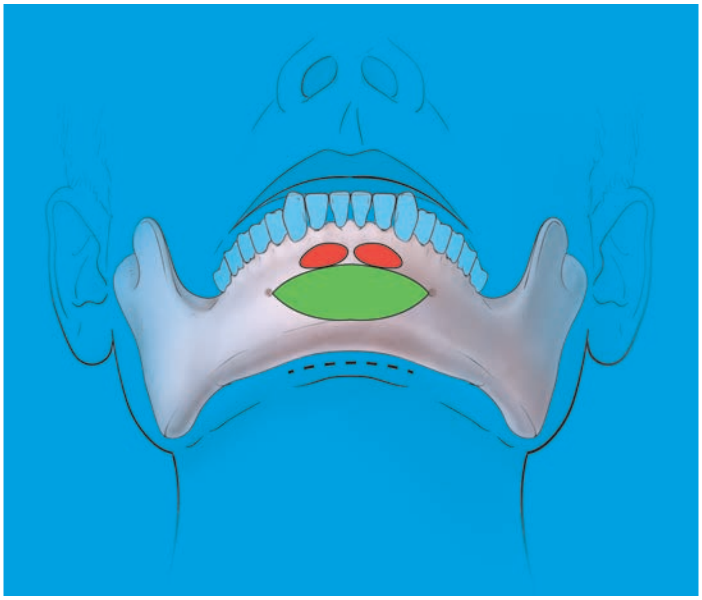
PART SEVEN

The Chin



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Dimensional Approach to Rhinoplasty: Perfecting the Aesthetic Balance Between the Nose and Chin

H. Steve Byrd ▪ P. Craig Hobar

Dimensional analysis is an objective system for assessment of the rhinoplasty and genioplasty patient; it is intended to eliminate an inadvertent oversight and subjective variations in treatment planning and outcome. It provides a reliable guide for accurately diagnosing facial imbalances and direct precise surgical treatment. This system is not intended to replace surgical artistic judgment but rather to enhance the surgeon's ability to deliver consistent, optimal results.

Implicit in a surgeon's ability to correct nasal and chin deformities is an understanding of facial aesthetic relationships. Classical Greek canons of facial proportions, long held as the standard of facial beauty, have been refuted by many authors.[1-3] Byrd and Hobar,[4,5] on the basis of their large rhinoplasty experience and study of attractive faces, found consistent ratios between the vertical and anterior relationships of the nose, lips, and chin. Using these relationships, they developed a system of dimensional analysis to determine optimal dimensional changes for rhinoplasty and genioplasty patients.

Ideal facial dimensions are specific for each individual's face. Faces can be attractive but different from the generic mean of features derived from a heterogeneous pool of attractive faces. It is unwise to attempt to surgically alter an attractive face with unique relationships to match generic means.[6-8] An aesthetically appealing chin and nose must be in balance with the rest of the face, and the characteristics for each should be derived from the patient's own facial components. For example, a patient with inadequate chin projection and a nose that is too large

may be treated by rhinoplasty alone to camouflage facial imbalance. However, a better aesthetic result may be possible if chin augmentation and nasal surgery are combined.

Facial dimensions should be evaluated on an individual basis, and a comprehensive analysis of each individual optimizes treatment planning.

Chin augmentation is a commonly performed operation, both alone and in conjunction with rhinoplasty. Although the rewards of this relatively simple procedure can be extremely gratifying for both the patient and the surgeon, inadequate attention to analysis and anatomic principles and improper selection of operative technique can lead to suboptimal results.

Surgical alteration of the chin can be extremely rewarding and can enhance concomitant procedures such as rhinoplasty and face lift, although proper preoperative analysis and careful treatment planning are essential.

DIMENSIONAL ABNORMALITIES

Dimensional abnormalities are common among patients seeking rhinoplasty, and the surgeon intent on achieving the best aesthetic result should develop a system of analysis for assessing these problems. Such dimensional abnormalities include excessive or inadequate nasal length, excessive or inadequate radix projection, and excessive or inadequate tip projection. Dimensional abnormalities of the chin include excessive or inadequate projection and excessive or inadequate vertical height.

DIMENSIONAL ANALYSIS AND SURGICAL PLANNING

Malocclusion is an indication for cephalometric analysis, orthodontic evaluation, and treatment planning according to orthognathic standards. In the absence of malocclusion, measurements based on selected topographic landmarks are taken directly from the patient with a ruler or caliper with millimeter increments; this takes less than 5 minutes. The important measurements for the nose, face, and chin can be obtained from these landmarks, and from these measurements reference planes can be derived that guide the treatment planning.

Chin surgery may be performed to camouflage facial imbalance, although consideration of underlying dentofacial disharmony should be part of the preoperative evaluation.

Method of Dimensional Analysis

The selected topographic landmarks include the glabella *(G_s)*, nasal root or radix *(R)*, nasal tip *(T)*, stomion *(S)*, and menton *(Me_s)*. The subscript *s* is used to denote the soft tissue equivalent of the underlying bony landmark.

The glabella *(G_s)* is the clinically palpable and usually visible anatomic midline point in the lower forehead where the nasofrontal inclination begins. The nasal root or radix *(R)* is a point on the midline nasal dorsum at the level of the supratarsal folds. It is purposely selected as a nonnasal landmark to differentiate a

short nose from a nose that is of adequate length but that appears short because of a low radix breakpoint. An abnormal radix should not influence the measurement of nasal length. The majority of patients seeking rhinoplasty will not be affected by an abnormal supratarsal fold, but if one is encountered, the radix can be reliably measured in the midline 6 mm above the inner canthus. The nasal tip *(T)* is the midline point of the nasal tip taken at the level of the dome projecting points of the lower lateral cartilages. The stomion *(S)* is the midline point at the junction of the upper and lower lip vermilion. The menton *(Me_s)* is the lowermost midline point on the inferior border of the chin.

The alar base plane *(ABP)* runs transversely through the alar bases and is the most consistent vertical division between the midface and the lower face. As an aesthetic reference for midfacial height, the ABP is less variable than the subnasale, which is altered by the prominence of the caudal septum and nasal spine. If one of the alar bases is abnormal, the ABP is taken through the normal alar base and is perpendicular to the midline vertical axis of the face.

The corneal plane *(CP)* is a coronal plane tangential to the surface of the cornea. The CP is used as a reference from which radix projection is measured. The radix plane *(RP)* is a coronal plane tangential to the deepest point of the radix. The alar-cheek junction *(ACJ)* is a coronal plane that passes through the junction of the nasal alae and the cheek. The nasal tip plane *(TP)* is a coronal plane that passes through the most anterior projecting point of the nose.

The nose-lip-chin plane *(NLCP)* extends from a point one half the distance of the ideal nasal length *(RTi)* through the upper and lower lip vermilion. This plane identifies the aesthetic link between nasal length and lip and chin projection.

From these landmarks and reference planes the critical measurements for the nose, face, and chin can be obtained:

- Midfacial height *(MFH)* (from *G* to *ABP*)
- Lower facial height *(LFH)* (from *ABP* to Me_s) *RT* (from *R* to *T*)
- SMe (from *S* to Me_s)
- Radix projection (from *CP* to *RP*)
- Tip projection (from *ACJ* to *TP*)
- Chin projection (from the anteriormost projecting point of the chin to *NLCP*)

Clinical Analysis and Surgical Planning

The key principles for a clinically useful system of analysis are as follows:

- MFH should be equal to or slightly less (3 mm) than LFH.
- Ideal nasal length (RTi) can be different from actual nasal length (RT) and is defined by measurements taken from the lower face or midface.

$$RTi = SMe_s \text{ or } RTi = 0.67 \times MFH$$

- Nasal tip projection should be 0.67 RTi.
- Ideal radix projection should be 0.28 RTi.
- Chin projection should be 3 mm back from NLCP when NLCP is drawn from ½ RTi.

The fundamental step in facial analysis is to determine the ideal nasal length for a specific face.

The ideal nasal length does not reflect an anthropometric standard, but instead is most consistent with measurements and relationships in the midface and lower face. The recommended sequence of analysis is as follows:

1. Determine the vertical height of the midface and lower face. MFH should be equal to or slightly less (3 mm) than LFH. If it is not, reaffirm occlusion and look specifically for the presence of long- or short-face syndrome, or microgenia.

$$MFH = LFH \text{ (3 mm)}$$

2. Select the mid or lower facial subunit as the standard for determining ideal nasal length.

$$NRTi = SMe_s \text{ or } RTi = 0.67 \times MFH$$

   When the mandible is normal and the midface and lower face are nearly equal, nasal length should be planned on the basis of chin vertical (that is, $RTi = SMe_s$). In cases of microgenia or maldevelopment of the mandible, the ideal nasal length is determined from the midfacial height. Similarly, when the midface is overdeveloped and is not to be corrected orthognathically, the nose should be proportional to the midface rather than to the smaller mandibular segment.

$$RTi = SMe_s \text{ or } RTi = 0.67 \times MFH$$

3. With the ideal nasal length established in step 2, the adjustments to the existing nasal length and possibly the chin vertical can be planned to approximate the ideal nasal length. The treatment plan is ultimately determined by safe and reliable surgical guidelines.
4. Multiply the ideal nasal length by 0.67 to determine the ideal tip projection. If the actual tip projection is equal to or greater than the calculated value, then tip projection is adequate despite its appearance in relation to the dorsum. If actual tip projection is less than the calculated ideal, surgical steps to increase tip support should be considered.

$$\text{Ideal tip projection} = 0.67 \times \text{RTi}$$

5. Measure the distance between the corneal plane and the radix plane. If it is less than 0.28 RTi and a dorsal hump is present, a radix graft should be considered. If it is greater than 0.28 RTi and there is a poorly defined radix breakpoint, radix reduction should be considered.

$$\text{Ideal radix projection} = 0.28 \times \text{RTi (9 to 14 mm)}$$

6. Note any difference in nasal length when measured from the level of the supratarsal fold (R) and the visual radix breakpoint. If nasal length is normal as measured from R but the nose appears short because of a low breakpoint, it can be corrected with a radix graft to raise the visual breakpoint.
7. Mark a point on the dorsum of the nose equivalent to one half the ideal nasal length as measured from R. Drop a line from this point tangential to the vermilion surface of the upper lip. The projecting surface of the chin should lie approximately 3 mm back from this plane. The vertical requirements of the chin are described in step 3.

$$\text{Chin projection} = -3 \text{ mm NLCP}$$

Analysis of midfacial height, ideal nasal length, and chin projection set the stage for treatment planning for genioplasty.

Relationship Summary for Dimensional Analysis

1. MFH is the distance from G_s to ABP. It should be equal to or slightly less (3 mm or less) than the LFH.
2. LFH is the distance from ABP to Me_s. It should be equal to or slightly greater than 3 mm MFH. If the LFH is outside of the preceding range, suspect an abnormality in vertical chin dimension or MFH.
3. Nasal length (RT) is the distance of R at the level of the superior palpebral fold (SPF) to T.
4. Ideal nasal length (RTi) is equal to SME_s (stomion-menton distance) if the MFH and LFH are appropriate, and 67% of MFH in cases of vertical chin deficiency.
5. Radix projection is 28% of RT and is measured from CP to R at the superior palpebral fold.
6. Tip projection is the distance from ACJ to T and should correspond to 67% of RTi.
7. The NLCP is drawn from ½ RTi (the point on the nasal dorsum one half the distance of RTi from R) to the anteriormost projecting point of the upper lip vermilion. Chin projection can be up to 3 mm posterior to this line in women and should approximate the line in men.

COMPARISONS WITH OTHER METHODS OF FACIAL ANALYSIS

Other methods of facial analysis describe the nasal length as the distance from the nasion to the most projecting point of the tip of the nose in the midaxis (pronasale); from the nasion to the maximal point of dome projection (tip); or from the nasion to the caudal or inferior border of the columella.[1,6-9] Although these landmarks can be altered surgically, all may be collectively or independently involved in the nasal pathology. The nasion, the common beginning reference, varies widely in both its projection and vertical position in white individuals with normal noses, not to mention its variance in position in a congenitally foreshortened nose and a traumatic nasal deformity. In the proposed method of analysis, the nasal root (R) is empirically set at the level of the supratarsal eyelid fold, a nonnasal reference. If the supratarsal fold is absent, asymmetrical, or difficult to identify, the same plane may be identified by measuring 6 mm above the inner canthus. With R defined in this manner, a low nasofrontal angle is easily identifiable and nasal length relative to the facial skeleton can still be determined without confusion.

This determination becomes extremely valuable in distinguishing a truly foreshortened nose from a nose of normal length but with a low frontonasal angle. In the former case, osteotomies may be required, whereas in the latter case a simple

radix augmentation graft may suffice. Radix projection is described relative to the corneal plane instead of the forehead to avoid the potential errors induced by orbital rim bossing or hypoplasia. It is well recognized that the corneal position may itself be affected by disease and trauma, and when this occurs, it is not a reliable reference.

Nasal tip projection is related to nasal length and is measured from the alar base plane rather than as an angle of inclination from the facial plane. A 2-degree error in measuring the angle of inclination of the nasal bridge at point R will create an error in tip position of 2 to 3 mm in noses of average length. This potential error in measurement is frequently greater than the requirements for surgical change.

The key step in this system of analysis is to establish the ideal nasal length for the individual. Once this is determined, the ideal nasal length becomes the basis of calculations for the patient's radix projection, tip projection, chin vertical, and chin projection.

The nose-lip-chin plane allows determination of the desired chin projection based on both ideal nasal length and lip projection, thereby linking the vertical and projecting characteristics of these subunits.

Other frequently used methods of determining chin projection invariably fail to consider the vertical and projecting characteristics of the individual subunits of the nose-lip-chin complex. Although the aesthetic eye of the surgeon is an invaluable aid in determining facial imbalances, this too is subject to variation and biases not associated with a set system of analysis. Analysis should not replace surgical judgment but should be used to enhance it by providing a reliable guideline in surgical planning that eliminates oversights and subjective variations. Furthermore, it provides objective data that can be used to evaluate postoperative results and allow critical review of the surgeon's ability to achieve the desired results.

Potential pitfalls in this method of analysis include inaccuracies in clinical measurements and the use of actual nasal length instead of ideal nasal length in planning nose, lip, and chin relations. In rhinoplasty patients with significant facial and nasal disproportions, ideal nasal length (RTi) must be determined from nonnasal references and actual nasal length (RT) should be assumed incorrect until proven otherwise.

SURGERY OF THE CHIN

Preoperative Assessment and Planning

Dimensional analysis evaluates the nose, lips, and chin as a single aesthetic complex and provides a simple, expedient way to avoid overlooking abnormalities in either chin vertical dimension or projection. Malocclusion requires orthognathic surgery, which precludes the use of dimensional analysis as described in this chapter.

Surgical alteration of the chin can enhance the results of rhinoplasty by improving facial disharmony.

Eight categories of chin abnormalities can be determined from this method of analysis:

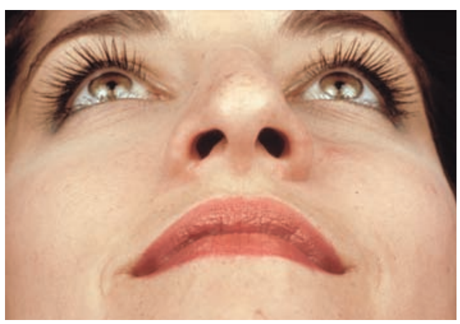
1. Inadequate chin projection
2. Inadequate chin vertical dimension
3. Excessive chin projection
4. Excessive chin vertical dimension
5. Inadequate chin projection and inadequate chin vertical dimension
6. Inadequate chin projection and excessive chin vertical dimension
7. Excessive chin projection and inadequate chin vertical dimension
8. Excessive chin projection and excessive chin vertical dimension

The vast majority of rhinoplasty patients with chin disharmony have inadequate chin projection, either alone or in combination with inadequate chin vertical dimension. However, any of the aforementioned combinations may be seen. Correction of excess chin projection and chin vertical dimension should be tempered with sound surgical judgment, because anything more than a minor change may produce a redundancy in the soft tissue envelope. Careful attention to technique and a conservative approach will minimize the chances of this occurring. Patients with a retrusive lower lip and a deep labiomental fold may appear overcorrected if horizontal chin augmentation projects anterior to the lower lip. In these patients, visual compensation for weak projection can be achieved by increasing the vertical dimension as long as there is no preoperative lip strain.[10]

A balanced and harmonious relationship should exist between the nose, the upper and lower lips, and the chin with respect to vertical height and projection.

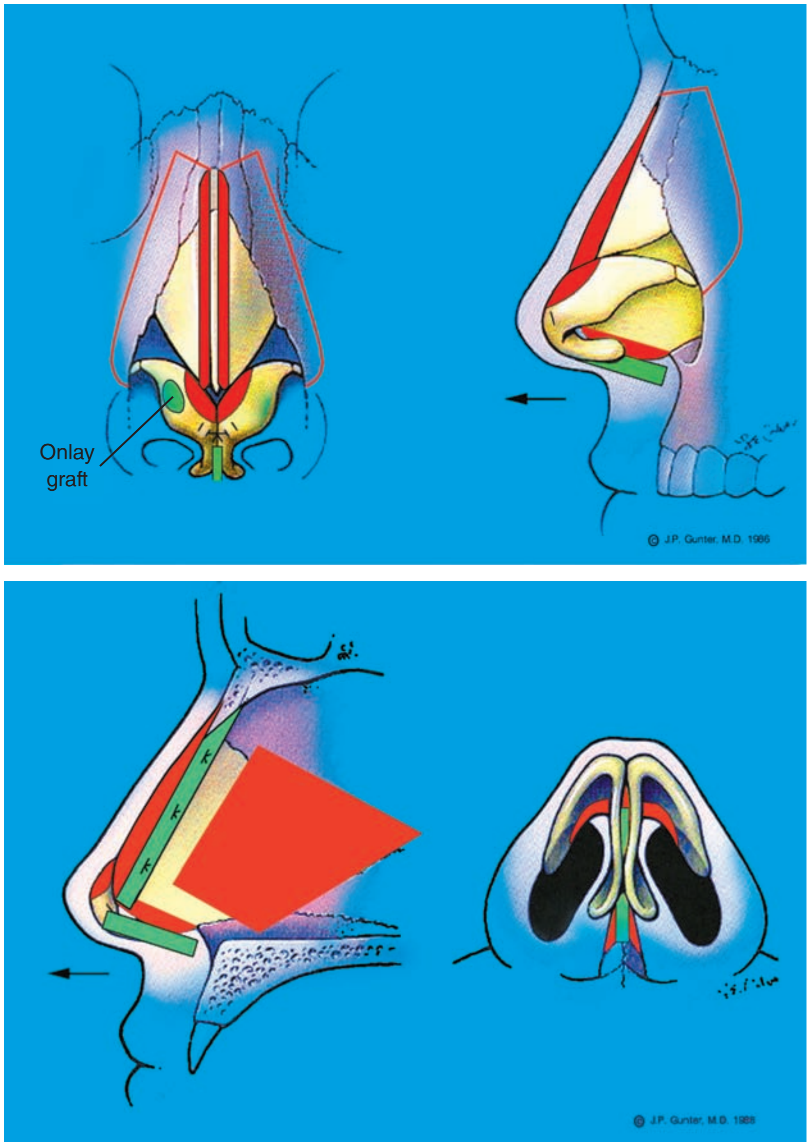
Treatment options include placement of a chin implant or mandibular osteotomy. The selection of one method over another is frequently a personal choice based on the surgeon's experience and the patient's desires. Although both methods may yield equally good results in a number of cases, each has advantages and limitations that must be understood to yield optimal results in all situations.

CASE ANALYSES



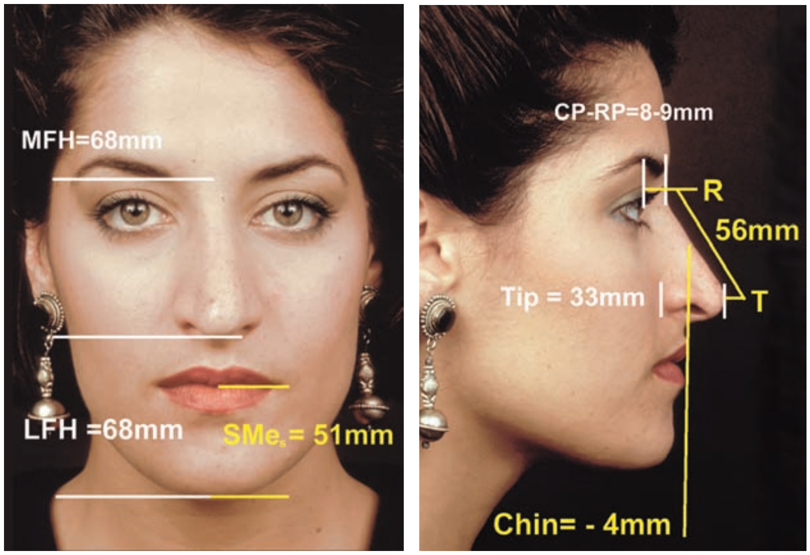
This 24-year-old woman with thin skin was primarily concerned about her drooping nasal tip and crooked dorsum. She had worn braces for an overbite as an adolescent. No dental extractions were required during orthodontics. The preoperative photographs confirmed a deviation of the septum with convexity on the left, which forced the tip off midline to the right. The width of the nose along the dorsum and along its base was satisfactory. A supratip break was absent, and there was a slight overprojection of the dorsum relative to the radix. She had a short upper lip and a long nose. The columellar-labial angle was approximately 85 degrees.

Surgical Plan

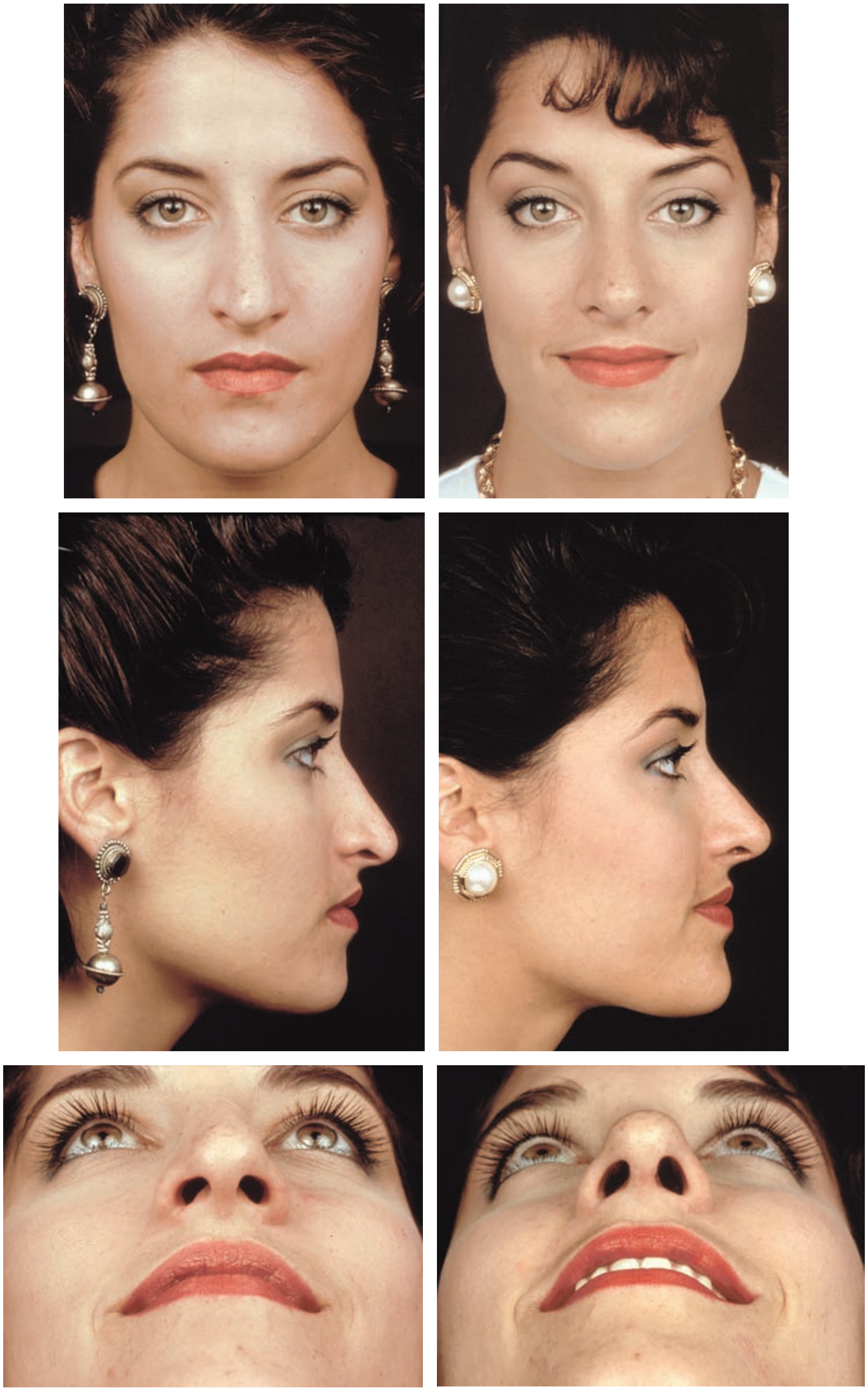


The clinical measurements were as follows:

MFH = 68 mm
LFH = 68 mm
RT = 56 mm
SMe_s = 51 mm
Distance between corneal plane and radix (i C-R) = 13 mm
Tip projection = 33 mm
Chin projection = 24 mm



1. MFH and LFH were in good balance but vertically strong.
2. There was a discrepancy when ideal nasal length was calculated: RTi = 0.67 × 68 mm = 46 mm; RTi = SMe_s = 51 mm. When these discrepancies occur, always choose the reference suggesting the least amount of change (in this case SMe_s). The maximum degree of nasal shortening that can be reliably achieved without distorting intrinsic anatomy and aesthetics is 4 mm. Plans to shorten the nose 3 to 4 mm will result in a nasal length of 52 to 53 mm.
3. Planned changes in tip projection: The actual tip projection was 33 mm. The final nasal length will be 52 mm; therefore tip projection should be 0.67 × 52 mm = 35 mm. The columellar strut graft will be used to gain 1 to 2 mm in tip projection.
4. Planned changes in radix projection: The patient's ideal radix projection is 0.28 × 52 mm = 14 mm. The option of a radix graft after reviewing the computer images was discussed, but the patient declined radix augmentation because she thought it made her eyes appear too narrow. Accordingly, no change in radix projection was planned.
5. The visual radix breakpoint corresponded to the level of the supratarsal fold; thus no changes were planned.
6. Planned changes in the dorsum: The dorsum will be reduced to give a slight retroussé according to the patient's preference.
7. Planned changes in the chin: The patient's chin fell 4 mm short of the nose-lip-chin plane; thus no changes in the anterior projection are planned. Her nasal length will be 1 to 2 mm greater than her chin vertical. A 1 to 2 mm increase in chin vertical would improve balance, but the proposed dimensional change is not of sufficient magnitude to justify surgical modification of the chin.

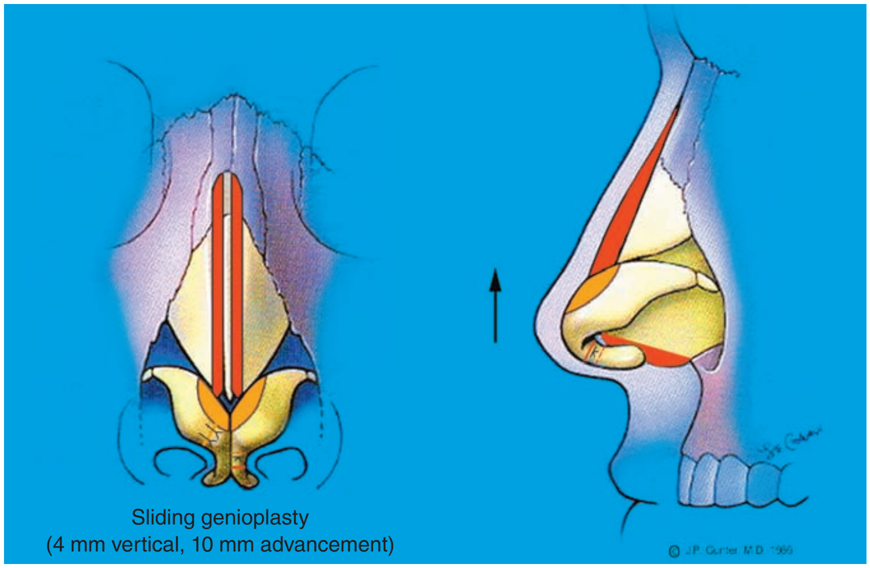


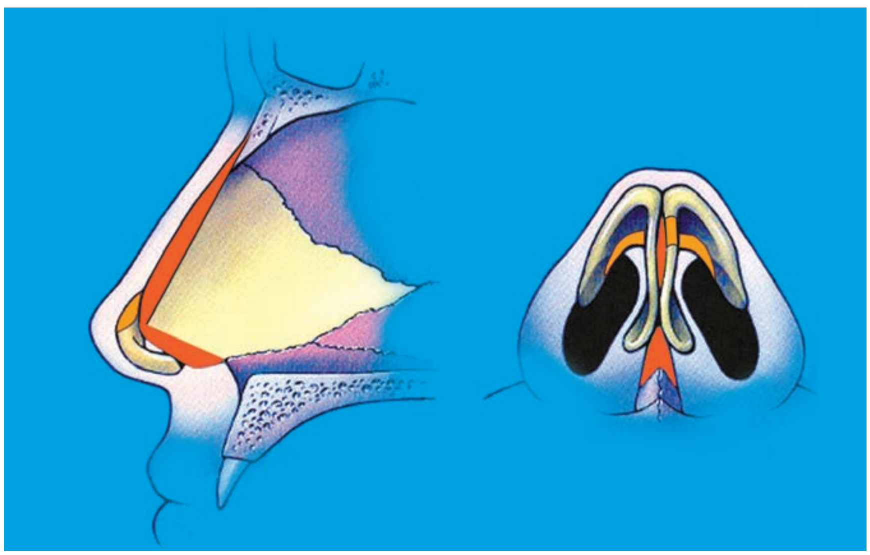
The patient is shown 18 months after surgery. Her vertically elongated face required a proportionately long nose with appropriately adjusted tip projection.

Using aesthetic norms for nasal length and tip projection while ignoring the facial disproportions will result in the nose appearing overdone. The anteroposterior and lateral views show the original preoperative photograph, the computer image changes based on the dimensional analysis, and the computer image changes based on traditional aesthetic norms. The use of the dimensional approach will help in achieving balanced nasal results, particularly in the disproportioned face, as illustrated in this case example.

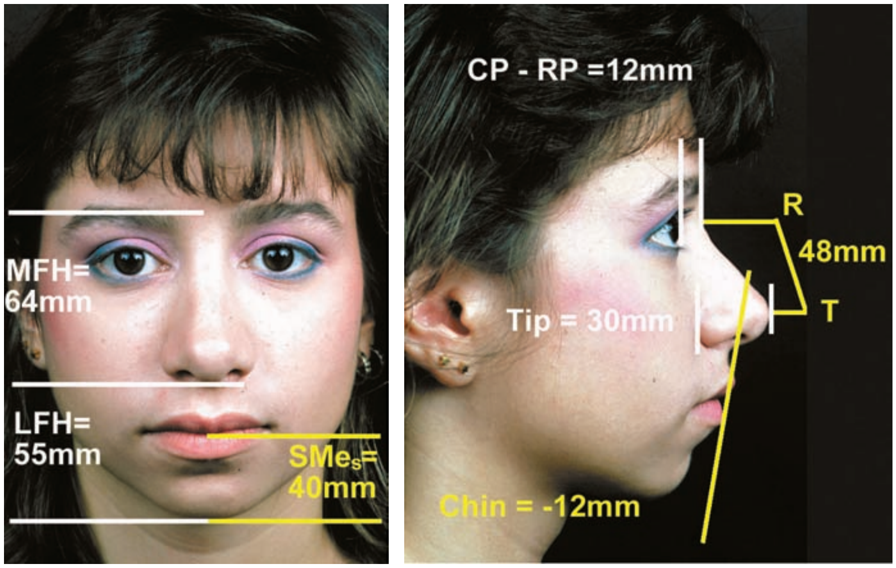
This 17-year-old patient who had previously had rhinoplasty complained that her nose appeared too large for her face. She thought her nasal tip was too projecting and large. The frontal view showed asymmetry at the dome projecting points with a deviation of the tip and caudal septum to the left. The tip-lobule complex was broad and somewhat thick. A very striking deficiency in chin vertical dimension and projection was noted, causing a strong illusion of an overly prominent mid-face and nose. The oblique view demonstrated a slight dorsal prominence and supratip break, both of which were objectionable to the patient. A slight dorsal prominence was seen on the lateral view. A columellar-labial angle slightly less than 90 degrees was also noted as well as a profound chin deficiency. On the basilar view the base of the columella was slightly off to the left, whereas the tip complex was slightly to the right of the midline. The nostrils were reasonably symmetrical, although a slight difference in projection of the domes was noted.

Surgical Plan





A sliding genioplasty through an intraoral approach with exposure of the mental nerves was performed. An osteotomy was carried 8 mm from the inferior border of the mandible 3 to 4 mm below the level of the mental nerve. Plate fixation of the chin produced 4 mm of vertical lengthening through rotation and a 10 mm forward advancement. Infracartilaginous and intercartilaginous incisions were made for delivery of the lower lateral cartilages. The right lateral crus had been divided previously and caused underprojection of the right dome compared to the left. The overprojected left lower lateral cartilage was reduced by a 1 mm Lipsett resection of the medial crus. The medial crus, middle crus, and dome segments were unified with sutures. The dorsum was skeletonized and the dorsal hump reduced with a rasp. Resection of 2 mm of caudal septum through a transfixion incision shortened the nose.



The clinical measurements were as follows:

MFH = 64 mm	CR = 12 mm
LFH = 55 mm	Tip projection = 30 mm
RT = 48 mm	Chin projection = 12 mm
SMe_s = 40 mm	

1. The LFH was significantly less than MFH, which indicated a major skeletal imbalance. Reexamination revealed a normal occlusion; however, the patient had a history of previous orthodontic therapy. Her deficient LFH was a result of her deficient chin vertical dimension.
2. In this case her LFH was abnormal, and her ideal nasal length should be calculated from her MFH: RTi = 0.67 × 64 = 43 mm.
3. Changes in nasal length were planned to approach the ideal nasal length. The maximal shortening that can be achieved reliably is 3 to 4 mm. A decrease in nasal length of 3 to 4 mm was planned.
4. Changes in tip projection were planned. Her actual tip projection was 30 mm. Her final nasal length will be 44 to 45 mm. Therefore tip projection will be maintained or decreased 1 mm. Extensive mobilization of the lower lateral cartilages or a transfixion incision predisposes to a 1 to 2 mm decrease in tip projection. To prevent an undesired decrease in tip projection from these maneuvers, a columellar strut graft is routinely used.

5. Changes in radix projection were planned. Her ideal radix projection is 0.28 × 44 mm = 12 mm. Her actual radix projection was 12 mm; therefore radix augmentation is not indicated.
6. The visual radix breakpoint corresponded to the level of the superior palpebral fold.
7. Changes in the dorsum were planned with the dorsum to be reduced slightly to remove the minimal hump and give the desired straight dorsum.
8. Changes in the chin were planned. Her chin was markedly deficient in anterior projection. It fell 12 mm short of the NLCP when the NLCP was drawn 22 mm (half the ideal nasal length) from the R point. As we know from the analysis in step 1, her chin vertical needed to be increased at least 4 mm (SMe_s should be equal to RT). To produce ideal chin projection, her chin needed to be advanced 9 mm. This degree of anterior advancement and increase in chin vertical dimension is achieved most reliably through an osteotomy.

The patient is shown 18 months after surgery. This case illustrates the problems associated with a previous rhinoplasty carried out to make the nose fit a deficient chin. The patient's preoccupation with an enlarged nose was still apparent at the time of her second consultation. Although nasal length was excessive, the primary problem was deficient chin projection and chin vertical dimension.

Once the patient's chin was properly addressed, the principal focus of the rhinoplasty was resolving asymmetries and irregularities resulting from the initial procedure. The patient desired a straight dorsum; however, a dorsum with retroussé would have been another aesthetic option.

CONCLUSION

A balanced and harmonious relationship should exist between the nose, lips, and chin with respect to both vertical height and projection. The key step in dimensional analysis is to establish the ideal nasal length. Once this is determined, the ideal nasal length becomes the basis of calculations for chin vertical dimension and chin projection. The nose-lip-chin plane allows determination of desired chin projection based on both ideal nasal length and tip projections, thereby linking the vertical and projecting characteristics of these subunits. Other frequently used methods of determining chin projection invariably fail to consider both the vertical and projecting characteristics of the nose-lip-chin complex.

Personal pitfalls in this method of analysis include inaccuracies in clinical measurements and the use of actual nasal length instead of ideal nasal length in planning nose, lip, and chin relations. In patients with nonstandard faces who seek rhinoplasty, the surgeon must determine the ideal nasal length from nonnasal references and assume actual nasal length to be in error until proved otherwise.

Preoperative dimensional analysis for genioplasty should consider values of vertical and projecting facial subunits on which to base treatment plan options.

The aesthetic eye of the surgeon is an invaluable aid in evaluating patients for rhinoplasty and genioplasty, but it is subject to variation and biases. Dimensional analysis provides an objective standard for diagnosing facial imbalances and directing precise surgical treatment. This system is not intended to replace surgical judgment but to enhance it by providing a reliable guideline in surgical planning by eliminating oversights and subjective variations. Furthermore, dimensional analysis provides objective data that can be used to evaluate postoperative results and allow critical review of one's ability to achieve the desired results.

KEY POINTS

- Facial dimensions should be evaluated on an individual basis, and a comprehensive analysis of each individual optimizes treatment planning.
- Surgical alteration of the chin can be extremely rewarding and can enhance concomitant procedures such as rhinoplasty and face lift, although proper preoperative analysis and careful treatment planning are essential.
- Chin surgery may be performed to camouflage facial imbalance, although consideration of underlying dentofacial disharmony should be part of the preoperative evaluation.

- The fundamental step in facial analysis is to determine the ideal nasal length for a specific face.
- Analysis of midfacial height, ideal nasal length, and chin projection set the stage for treatment planning for genioplasty.
- The key step in this system of analysis is to establish the ideal nasal length for the individual. Once this is determined, the ideal nasal length becomes the basis of calculations for the patient's radix projection, tip projection, chin vertical, and chin projection.
- Surgical alteration of the chin can enhance the results of rhinoplasty by improving facial disharmony.
- A balanced and harmonious relationship should exist between the nose, the upper and lower lips, and the chin with respect to both vertical height and projection.
- Preoperative dimensional analysis for genioplasty should consider values of vertical and projecting facial subunits on which to base treatment plan options.

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35

Chin Augmentation With Implants or Soft Tissue Fillers

Fadi C. Constantine ▪ Jamil Ahmad ▪ Rod J. Rohrich

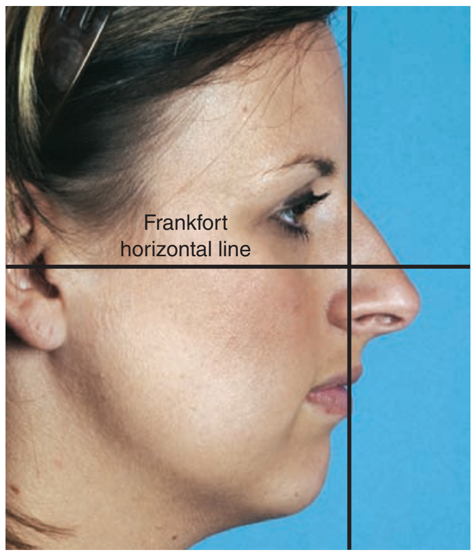
Alloplastic chin augmentation is the most commonly performed facial skeletal augmentation procedure in the United States,[1] and demand continues to grow for the procedure. In a study that examined the proportion of rhinoplasty patients who could benefit from chin augmentation using a variety of different methods of assessment, the authors reported that depending on the method of assessment, 17% to 62% of males fulfilled criteria for chin augmentation, while 42% to 81% of females met the specified criteria.[2] Another study showed that an estimated 20% to 25% of patients requesting rhinoplasty could benefit from chin augmentation for better facial balance.[3]

CLINICAL ANALYSIS

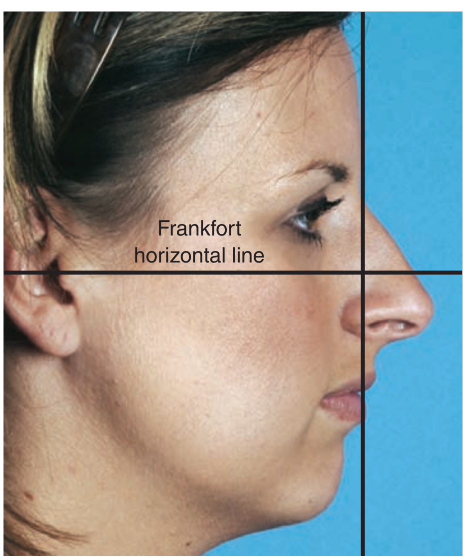
Aesthetic balance of the face is a frequently debated topic among aesthetic surgeons. In general, the ideal face has harmony and balance of the facial landmarks. Ideal relationships between facial landmarks and their relative proportions will contribute to overall facial harmony and balance. The profile view is particularly sensitive to these relationships, and disproportionate relationships disrupt the aesthetic balance of the face. Most attention is focused on the middle third (nose) of the face, since it is usually the most projecting part of the face in profile. However, the lower third (lips and chin) of the face must also be evaluated, because failure to address significant imbalance of the nose-chin relationship will result in a less than ideal overall result. For example, a patient with microgenia may appear to have a large nose, whereas a macrogenic profile may overwhelm a less prominent nose.

Many different methods of facial analysis to evaluate the adequacy of the chin have been described, but no one method of assessment has been universally accepted.

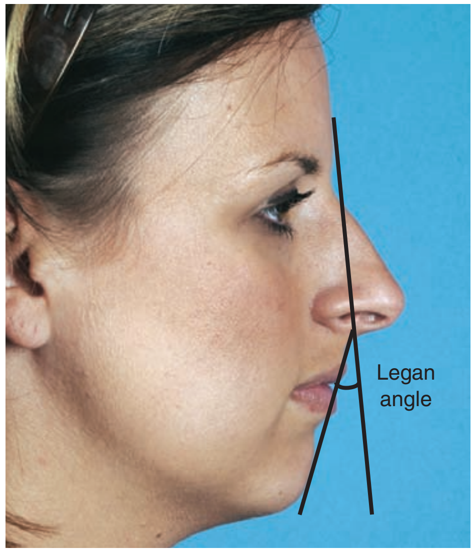
Byrd[4,5] advocated dimensional analysis for planning rhinoplasty and genioplasty. The nose-lip-chin plane allows the surgeon to determine the desired chin projection based on both ideal nasal length and lip projection, thereby linking the vertical and projecting characteristics of these subunits.



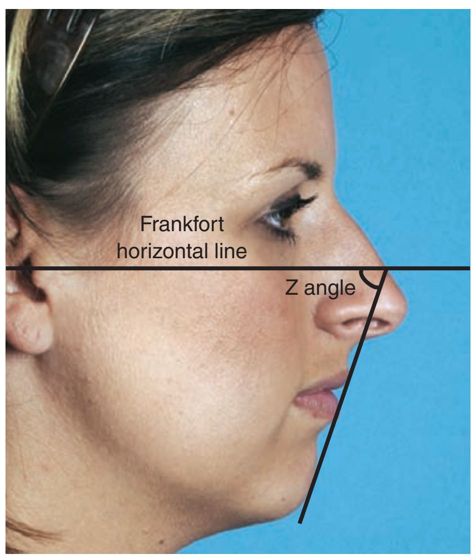
In Silver's method,[6] a perpendicular line is dropped from the Frankfort horizontal line tangent to the lower lip's vermilion-cutaneous border. The pogonion should be at or up to 2 mm behind this line; the latter may be preferred for women.



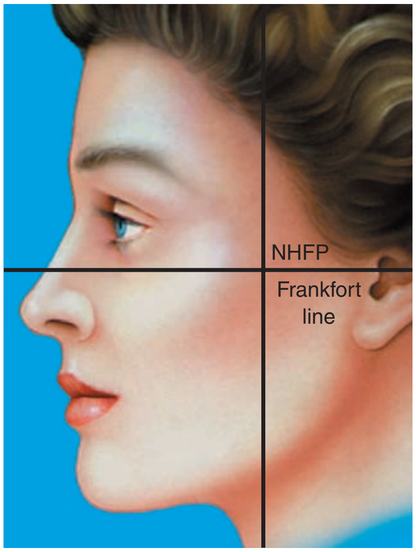
Gonzalez-Ulloa[7] stated that the chin should be at or just behind a line perpendicular to the Frankfort horizontal plane passing through the nasion, referred to as *zero meridian.*

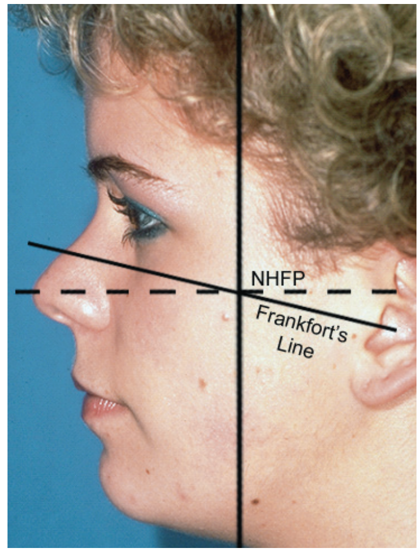


Legan and Burnstone[8] used soft tissue cephalometric analysis to evaluate facial convexity. The ideal angle of facial convexity is between 8 and 16 degrees and defined as the angle subtended by a line passed through the glabella and subnasale to that of a line connecting the subnasale to the soft tissue pogonion.

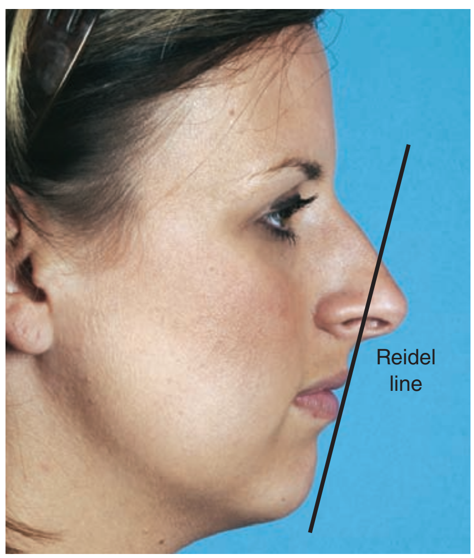


Similarly, Merrifield's *Z angle*[9] is that between a line tangent to the pogonion and anterior most upper lip and the Frankfort horizontal line. This is said to be between 75 and 85 degrees.





Because many of these methods of evaluation (and others) use the Frankfort horizontal line, one must keep in mind that the facial structure of many patients does not adhere to the classic description of such a line. In individuals with low-set ears, gross miscalculations of nose-lip-chin relationships might occur.



The Riedel line is independent of the Frankfort line. Instead, with the ideal chin projection present, the most projecting portion of the upper lip, lower lip and chin should all be tangent to the same line. If the chin lies posterior to the Riedel line, horizontal microgenia exists.

With the head in neutral position and the patient looking forward, we prefer to use a vertical line dropped from the most anterior aspect of the lower lip to measure the adequacy of chin projection during facial analysis. This method is simple and practical. In men, the most projecting portion of the chin should be at this vertical line; in women, the most projecting portion of the chin usually lies about 2 mm behind this line.

With the head in neutral position and the patient looking forward, we prefer to use a vertical line dropped from the anteriormost aspect of the lower lip to measure the adequacy of chin projection during facial analysis.

Although the aesthetic eye of the surgeon is an invaluable tool in determining facial imbalances, it is subject to variation and biases not associated with an objective method of analysis. Analysis should not replace good surgical judgment but should be used to enhance it by providing a reliable guideline in surgical planning that eliminates oversights and subjective variations. Furthermore, it provides objective data that can used to evaluate postoperative results and allow critical review of the surgeon's ability to achieve the desired results.

Analysis should not replace good surgical judgment but should be used to enhance it by providing a reliable guideline in surgical planning that eliminates oversights and subjective variations.

TREATMENT OPTIONS

Treatment options include placement of a chin implant or mandibular osteotomy. More recently, nonsurgical chin augmentation using soft tissue fillers provides another option to achieve a minor degree of chin augmentation.

The selection of one method over another is frequently based on the surgeon's experience and the patient's desires. Although both methods may yield equally good results in a number of cases, each has advantages and limitations that must be understood to yield optimal results in all situations. Pertinent anatomic principles are discussed below followed by a description of each method.

Both osteoplastic genioplasty and alloplastic chin augmentation have many advantages and disadvantages. Alloplastic chin augmentation possesses numerous advantages over osteoplastic genioplasty including that the surgeon is able to perform precise and anatomic correction of the deformity with minimal contour irregularities, the operation is technically easier to perform, much less invasive when performed through a limited incision, and more economical. Recovery time is shorter, and significant complications are rare.

Advantages and Disadvantages of Osteoplastic Genioplasty

Advantages	Disadvantages
More versatile for greater horizontal augmentation and correction of vertical imbalances	Potentially irreversible injury to mental nerve with improper placement of osteotomy
Uses autologous tissue only	Lateral depression after advancement may require correction
	Longer recovery time
	Potential for worsening of prejowl sulcus

Advantages and Disadvantages of Alloplastic Chin Augmentation

Advantages	Disadvantages
Technically easier	Horizontal augmentation limited to mild to moderate cases
Intraoperative shaping	Potential bony resorption
Shorter recovery time	

ALLOPLASTIC CHIN AUGMENTATION

The main indication for placement of a chin implant is correction of minor deficiencies of chin projection (10 mm or less).[10-12] Augmentation greater than 10 mm is best achieved by osteoplastic genioplasty. A chin implant placed parallel to the

Frankfort horizontal plane increases chin projection without affecting vertical dimension. A minor degree of vertical chin deficiency can also be corrected if the implant is placed at the most anterior-inferior projecting point of the bony chin (gnathion) as a continuation of the inferior border. The maximal increase in vertical chin dimension that is usually obtained with a chin implant is 2 to 3 mm. Any vertical correction greater than 3 mm is best achieved by osteoplastic genioplasty.

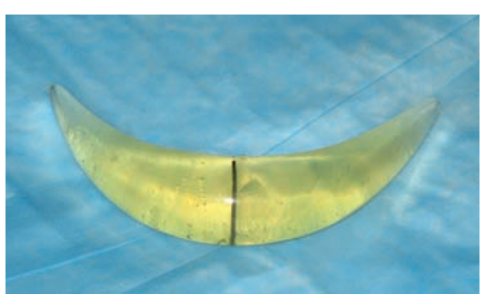
Alloplastic chin implants are best used for treating minor to moderate degrees of horizontal deficiency. Only a minimal correction of vertical deficiency may be achieved with an implant.

Alloplastic Materials

An ideal alloplastic implant for augmentation should be easily shaped and secured. It should also be inert, noninflammatory, and nonallergenic. It needs to integrate into the surrounding soft tissues but be easily explantable if it must be removed. It should maintain its desired form and consistency in situ and resist mechanical strain. The implant margins should also be tapered to blend into the bony surface of the mandible to avoid palpability or visibility through the soft tissues. Finally, the implant must be readily available and noncarcinogenic.

Solid Silicone

Solid silicone chin implants consist of crosslinked polymers made of repeating subunits of dimethylsiloxane. It is nonporous and does not allow any fibrovascular ingrowth.[13] Local inflammatory response to the silicone implants results in formation of a thin, dense fibrous capsule surrounding the implant. Solid silicone chin implants are available in a wide variety of shapes and sizes.



If they are mobile, solid implants can lead to seroma formation. If soft tissue cover is thin or under tension, extrusion may result. A literature review by Ellenbogen and Rubin[14] found a 0.7% infection rate, a 0.5% rate of extrusion, and a 0.5% rate of displacement of silicone chin implants.

Porous Polyethylene

Porous polyethylene is a biomaterial made of simple carbon chains. It is nonallergenic, nonantigenic, nonabsorbable, highly stable, easy to fixate, and available in a wide variety of preformed shapes.[13] Once submerged in hot water (greater than 82° C [180° F]), polyethylene becomes malleable. It has pores ranging from 100 to 250 µm (average 150 µm), which allows the ingrowth of soft tissue and bone and subsequent stabilization of the implant. However, this ingrowth can make removal of the implant difficult. One problem with porous polyethylene is its pliability and inability to contour well to the natural curve of the bony symphysis, which can result in a wider, more rounded, and less aesthetic outcome.

Polyamide Nylon Mesh

Polyamide nylon mesh is a softer material composed of nonabsorbable nylon polyester fibers woven into multifilament strands of polyethylene.[13] It has been used for more than 50 years and was first introduced for hernia repairs. It is noncarcinogenic, nondegradable, inexpensive, and causes minimal tissue reaction. It is cut easily and can be folded and constructed into an appropriate implant. It is porous, with 125 by 85 µm pores, and allows tissue ingrowth for subsequent stabilization of the implant. Studies have shown an overall complication rate ranging from 2.3% to 3.2% and an overall implant infection rate of 0.8% to 2.5%.[15,16] Soaking the mesh in antibiotic solution before implantation has been advised.

Polyamide

Polyamide is an organopolymer related to nylon and polyester fiber.[13] It can be folded, shaped, then secured using a polyamide suture. It is flexible and thus can be cut and contoured easily to underlying structures. The mesh elicits a moderate foreign body response and allows ingrowth of fibrous tissue over several months. This subsequently allows the implant to be fixed in place, but it also makes the implanted material difficult to remove. Complications have been reported, including transient edema, ecchymosis, collection of serous fluid, and some cases of resorption.[17]

Expanded Polytetrafluoroethylene

Expanded polytetrafluoroethylene (ePTFE) was the first biosynthetic material designed for implantation in humans.[13] It is nondegradable, biologically inert,

very pliable, and easily cut and shaped. It has small pores (average 22 μm) that allow fibrovascular ingrowth and subsequent stabilization of the implant. It does not elicit much of an inflammatory response; thus an enveloping capsule is not formed. In a review of 324 cases, Godin et al[18] found a 0.62% infection rate and no cases of extrusion or displacement. Unfortunately, ePTFE implants have been taken off the market because of problems with use of this implant in other areas of the face.

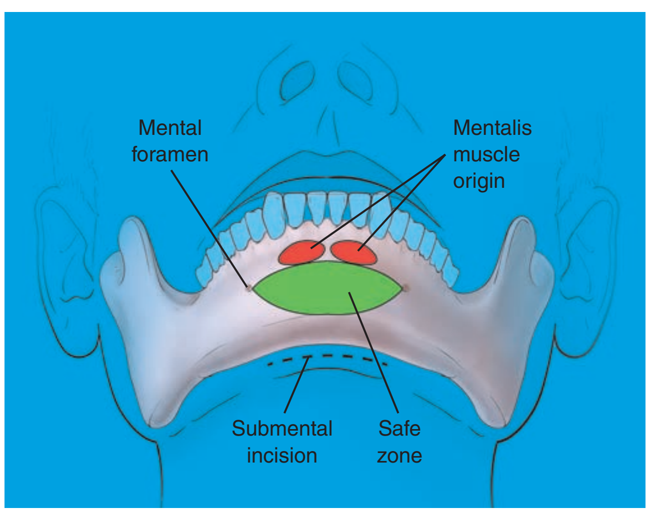
Hydroxyapatite Cement

Although not commonly used in such a capacity, hydroxyapatite cement is another alloplastic option for chin augmentation. It can be easily molded by hand and hardens rapidly. It must be placed in a subperiosteal plane in precisely dissected pockets to minimize displacement. Its osteoconductive properties play an important role in preventing migration as well as lowering the potential for postoperative infection.

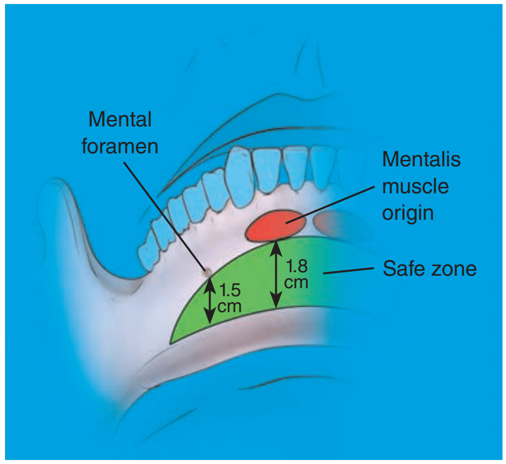
RELEVANT ANATOMY

Safe Zone of Dissection

In the standard submental approach, dissection is performed along the anterior mandible in the subperiosteal plane.[19] Above the mental protuberance, the upper limit of dissection is the origin of the mentalis muscle. Laterally, the mental foramen is identified below the root of the second premolar in which the exiting mental nerve is preserved.

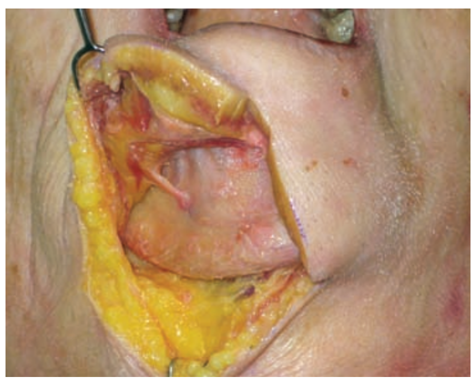


As described, a zone of safety can facilitate a more reliable approach for the placement of chin implants, avoiding the complications of lower lip incompetence or lower lip paresthesias.



According to Hazani et al,[19] the mentalis origin and the mental foramen were 18 ± 3 mm and 15 ± 2 mm cephalad to the inferior edge of the mandible, respectively. These distances define the borders of a safe zone above the mandibular border.

Mental Nerve Anatomy



The horizontal position of the mental foramen is below the second mandibular premolar or in the interdental space between the first and second premolar teeth in the majority of patients. On the vertical axis, the mental foramen is located approximately 15 mm above the mandibular border.

Mentalis Muscle Anatomy

The mentalis muscles are a pair of fan-shaped structures joined in the midline and are separated by a firm septum. The muscle originates from the alveolar process of the mandible below the incisor roots and then fans out to a more dispersed insertion into the chin just below the labiomental sulcus. Because the lower muscle fibers pass obliquely downward, an attempt to contract the mentalis

muscles will result in elevation of the lower lip.[20] When an intraoral approach is used, and the mentalis is divided, it should be reapproximated. Failure to do so can lead to chin ptosis, lip ptosis, drooling, and an increase in lower teeth show.[21]

Soft Tissue

Zide and McCarthy[20] demonstrated the critical importance of the mentalis muscle and delineated three abnormalities: inferior displacement of the origin of the mentalis muscle, excessive soft tissue envelope in relation to the bony chin, and deficiency of mentalis muscle. The first two conditions can result in ptosis of the soft tissue chin and/or lip incompetence.

Inferior displacement of the origin may occur with infection or improper resuturing of the mentalis muscle origin after chin degloving. Excessive soft tissue envelope may occur with burring of the anterior chin or aggressive surgical setback of the chin (it is much more common with the former). Deficiency of the mentalis muscle is the result of surgical resection and should be avoided.

Careful reconstruction of the origin of the mentalis muscle is critical for avoiding these complications. Zide and McCarthy[20] outlined a method of resuspending the origin of the mentalis muscle with a suture passed through the bony mandible for established deformities.

If an intraoral access is used, damage is likely to occur when the mentalis muscle is divided or stripped from the mandible to facilitate exposure for placement of an extended implant. Zide[22] maintained that in using this approach, the mentalis muscle's origins are always traversed. When a submental approach is used, overaggressive soft tissue dissection can result in mentalis muscle origin displacement.

OPERATIVE TECHNIQUE

Many implant materials have been advocated for chin augmentation. We prefer to use a solid silicone implant. Silicone implants come in a variety of thicknesses ranging from 4 to 10 mm, and can be further tailored to the patient with intraoperative carving. The choice of implant shape depends on the patient's anatomy and the desired correction. Narrow implants can provide acceptable contour when only a small amount of horizontal augmentation is desired or when an increase in anterior convexity is the goal. These implants, however, can create an unnatural lateral hollowing and can accentuate marionette lines and jowling. Therefore, narrow implants are indicated for minimal horizontal augmentation in patients with a square or boxy chin with an adequate lateral mandibular border

and youthful facial soft tissues. The wider or anatomic implant is the implant of choice in most patients. It provides a more natural contour of the lateral inferior border and avoids the pointed chin appearance that may accompany a narrow implant.

We have found alloplastic chin augmentation with solid silicone implants to be a safe and effective way to improve the nose-chin relationship during rhinoplasty. We prefer an extraoral approach through a submental incision.

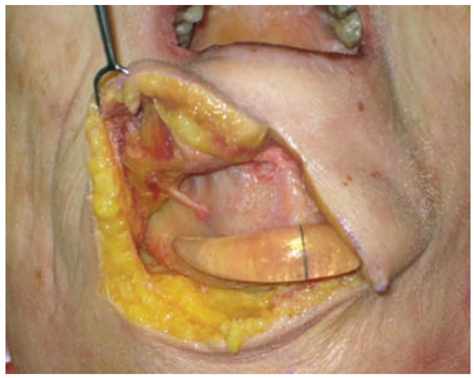
Submental Approach to Alloplastic Chin Augmentation

Chin implants can be placed through either intraoral or submental incisions. We prefer the submental approach as it allows placement of the implant through a sterile field, precise pocket dissection, less disruption of the overlying soft tissues, and the mental nerve is located out of the area of dissection. Placement of the implant can typically be done through a 1 to 2 cm incision.

A subperiosteal dissection plane is preferred for ease of dissection, bloodless field, and stabilization of the implant. The method also preserves the natural interface of the muscles with the periosteum, which may be important in preventing unnatural appearances during facial expressions.

Markings begin with marks over the midlines of the lower lip, chin, and thyroid cartilage. Local anesthetic (1% Lidocaine with epinephrine 1:100,000) is injected into the operative field (approximately 7 to 10 ml). A 1 to 2 cm curvilinear incision is placed in the submental crease. The incision is carried down with the electrocautery until the periosteal layer is reached at the inferior aspect of the mandible. The periosteum is incised and dissection is carried out in a subperiosteal fashion 1 cm superiorly and 5 cm laterally from the midline on each side. Dissection is performed in the zone of safety[19] and the mental nerve does not need to be visualized. Dissection is carried out along the inferior border of the mandible using a curved periosteal elevator with a superior limit of 1 cm to avoid the mental foramen. The size of the subperiosteal pocket must be precise; if it is too large, the implant might become displaced from its intended placement. However, if the pocket is too small, the implant might buckle, create overlying soft tissue problems, or even extrude. Anatomic implants require more dissection laterally

along the inferior border of the mandible to provide sufficient space for the entire implant. Care should be taken to avoid inadvertent penetration through the periosteum to a more superficial layer, because this may cause bleeding or injury to lip depressors. After the pocket dissection is complete, the implant is checked to ensure that it conforms to the anterior surface of the mandible. If it does not, it is modified with a scalpel. This avoids dead space with subsequent fluid collection and prevents an unnatural look caused by visibility of the implant.



The implant is rinsed in triple antibiotic solution (bacitracin, cephazolin, and gentamicin). The implant is placed in one side of the pocket and folded onto itself which enables the other side to slide into place. The implant should be placed over the cortical aspect of the bone on the inferior border overlying the gnathion. Placement of the implant too superiorly (infradentale) predisposes to excessive bony resorption from pressure on the relatively softer alveolar bone and risk to the dental roots, which may result in either implant infection or tooth loss. Additionally, superior placement may risk damage or compression of the mental nerve. When placing a wide implant, care must be taken to avoid impingement on the mental nerve as it exits its foramen, because this may lead to a compression neuropathy. The implant is then secured to the mandibular periosteum using 3-0 Vicryl sutures in three different locations. The subcutaneous tissues are reapproximated over the implant using 3-0 Vicryl sutures. The wound is irrigated and closed in layers.

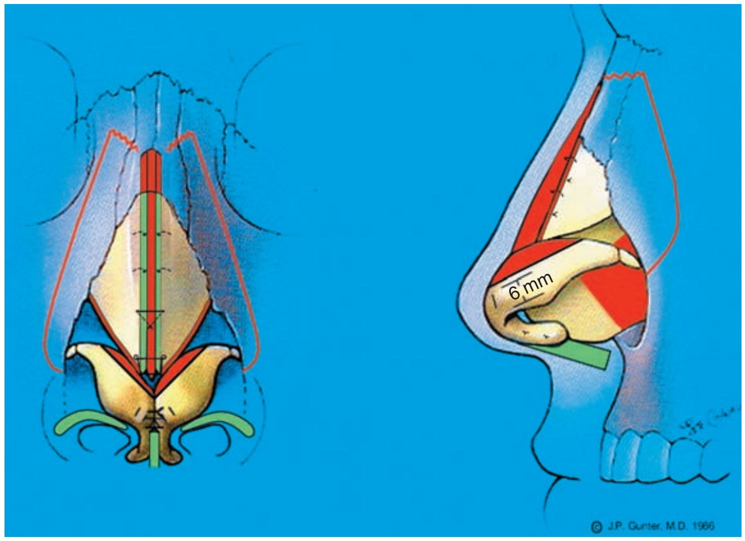
Patients can be discharged the day of surgery. They are restricted to a soft diet for 1 week. Oral antibiotics are prescribed for 1 day postoperatively.

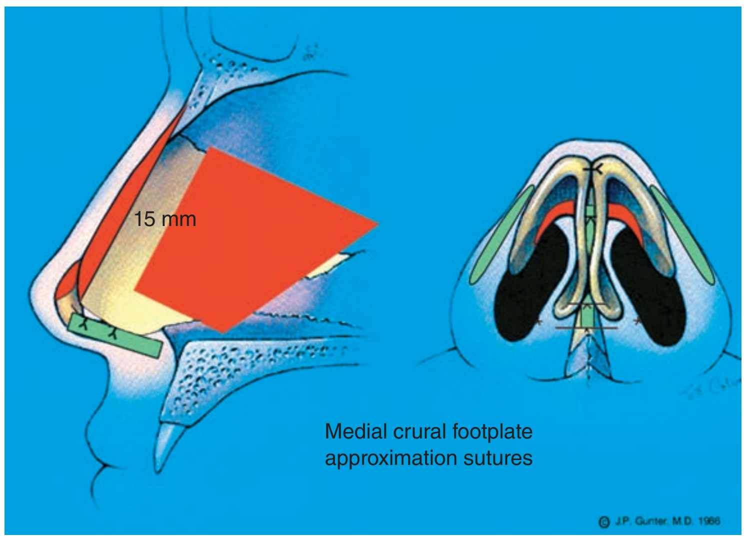
CASE ANALYSIS

This 30-year-old female presented with a dorsal hump, and an overprojected, boxy nasal tip. She also complained of nasal airway obstruction. In addition, she had microgenia and desired chin augmentation. Frontal view demonstrated asymmetric dorsal aesthetic lines with widely set tip-defining points. Lateral view reveals a moderate dorsal hump and overprojected, tension tip. Basal view shows the boxy tip clearly and a type II deformity of the columella with flaring of the medial crural footplates.

The operative goals included the following:

- Recreate symmetrical dorsal aesthetic lines.
- Reduce the dorsal hump.
- Decrease tip projection.
- Refine the nasal tip/tip-defining points.
- Correct flaring of the medial crural footplates.
- Perform chin augmentation.





Surgical Plan

1. Use open approach with a transcolumellar stair-step incision connected to bilateral infracartilaginous incisions.
2. Perform component dorsal hump reduction (4 mm).
3. Harvest septal cartilage leaving an L-strut.
4. Perform bilateral submucosal resection of the inferior turbinates.
5. Place bilateral autospreader flaps with upper lateral cartilage tension spanning suture restoration of the midvault.
6. Perform cephalic trim leaving a 6 mm alar rim strip.
7. Place columellar strut graft.
8. Use intercrural, interdomal, and transdomal suturing (5-0 PDS).
9. Place bilateral alar contour grafts.
10. Perform low-to-low percutaneous perforated lateral osteotomies.
11. Place medial crural footplate approximation sutures.
12. Augment the chin with solid silicone implant through a submental incision.

The patient is shown 12 months postoperatively. She has significant improvement in her dorsal aesthetic lines, correction of the dorsal hump, and tip refinement. On the basal view, she has better balance between the nasal base and tip as well as correction of the columellar base deformity. Additionally, she had restoration of normal bilateral nasal airflow. Chin augmentation has resulted in improved facial balance and a better nose-chin relationship.

COMPLICATIONS

The most frequent complication of alloplastic chin augmentation is asymmetry resulting from improper placement at the time of surgery.[11,21] Great care must be taken to precisely position the implant to prevent this technical error. Excessive dissection of the pocket predisposes to postoperative migration. Fixation of the implant and postoperative taping and immobilization with supportive garments may limit this occurrence. The incidence of infection associated with chin implantation is difficult to determine, but it is low—probably around 1%. There is no evidence to suggest that the infection rate is higher with an intraoral approach than with a submental approach. Successful treatment of infected implants has been reported with conservative measures, but implant removal is recommended. Injury to the mental nerve, injury to the mentalis or lower lip depressors, and hematoma are all possible but can be limited with careful attention to technique. Bony resorption under the implant occurs but is clinically insignificant as long as implants have less than 10 mm of projection and are properly placed on the inferior mandible cortical bone and not on the soft alveolar bone. Friedland et al[11] showed that unquestionably the most important factor to minimize bony resorption is proper placement of the implant.

Precise pocket dissection and attention to proper midline and vertical placement of a chin implant are required for a favorable result.

Complications

Alloplastic	Osseous
Dehiscence/extrusion	Dehiscence and infection
Infection	Hematoma
Malposition	Tooth devitalization
Bone resorption	Dental root exposure
Capsular contracture	Neurosensory loss
Lower lip retraction	Soft tissue ptosis
	Asymmetry
	Overcorrection/undercorrection
	Irregularities/step-off type deformities
	Lower lip retraction

NONSURGICAL CHIN AUGMENTATION

Although surgical management is the mainstay of treatment for chin augmentation, recent advancements in soft tissue fillers have added to the surgeon's armamentarium in correcting the aesthetic balance of the face.[23,24] One must note that soft tissue fillers are usually only beneficial for modest changes in projection. If a small (less than 2 mm) amount of augmentation is required and surgical treatment is not desired or not possible, soft tissue fillers may have a role in treatment. These treatments must be kept deep on the periosteum to prevent any overlying soft tissue irregularities. Products such as particulate hydroxyapatite (Radiesse; Merz, San Mateo, CA) and hyaluronic acid fillers (Juvéderm; Allergan, Irvine, CA) are good choices for noninvasive, modest chin augmentation. As with the majority of soft tissue fillers, they are temporary and require frequent reinjections to maintain the desired projection throughout a patient's life.

The use of autologous fat transfer has been described and is another potentially good option for nonsurgical chin augmentation; however, fat cell viability and take are unpredictable. Some have also described an unpredictable amount of fat cell growth with excessive weight gain. With all soft tissue fillers and fat grafting, one must be careful not to overaugment the chin and/or place the filler too superficially, because this can lead to excessive mobility or ptosis of the overlying soft tissue of the chin.

If a small (less than 2 mm) amount of augmentation is required and surgical treatment is not desired or not possible, soft tissue fillers may have a role in treatment.

Injection Technique

Several temporary soft tissue fillers are suitable for chin augmentation. Our preference is to use a highly crosslinked, mixed high and low molecular weight, hyaluronic acid product with lidocaine such as Juvéderm Voluma (Allergan). This product is relatively easy to inject and malleable and reliably provides volume augmentation when injected into the deep soft tissues of the face.

The skin is cleansed with a chlorhexidine-based solution before injection of the soft tissue filler. Juvéderm Voluma is supplied in 1 ml syringes. A 27-gauge needle is used. The product is injected in small depot injections of about 0.1 ml aliquots. Injections are placed along the mental protuberance of the anterior aspect of the mandible. The depth of injection should be just superficial to the periosteum. Following each depot injection, the area can be gently massaged to shape the product.

Injections are typically focused in the central chin deep within the soft tissue mass. However, injections can be continued laterally to the prejowl sulcus, depending on the type of augmentation and contouring required. When injecting laterally, the surgeon should palpate the facial artery in the premasseteric notch. During injection, the fingers on the nondominant hand should be used to apply digital pressure to occlude the facial artery to prevent inadvertent intravascular injection.

To avoid ptosis of the soft tissue mass of the chin, the injector should ensure that the soft tissue filler is placed superior to the inferior border of the mandible. Additionally, total volume of soft tissue filler should be limited to 1 to 2 ml as its malleable nature may allow distortion of the area when injected in larger volumes.

The patient should avoid strenuous exercise, extensive sun or heat exposure, and alcohol consumption for 24 hours after injection to reduce excessive postinjection redness, bruising, or swelling. There will be a slight increase in the volume augmentation effect after the initial injection. Maximal effect will be achieved 4 to 6 weeks after injection, and further treatment should be delayed until this time. In our experience, the effects of this product can be noticed for 12 to 18 months after the treatment.

CASE ANALYSIS

This 21-year-old woman felt that her chin was retrusive and desired chin augmentation. She did not want to undergo a surgical procedure at the present time. Nasofacial analysis demonstrated moderate microgenia.

The treatment goals included the following:

- Perform nonsurgical chin augmentation.

Treatment Plan

1. Place 0.1 ml depot injections of Voluma along the anterior surface of the mental protuberance of the mandible.
2. Place the filler just superficial to the periosteum with care to ensure that it is superior to the inferior border of the mandible.
3. Use a total of 0.8 ml of Voluma.

The patient is shown after her nonsurgical chin augmentation with improved nasofacial balance.

KEY POINTS

- With the head in neutral position and the patient looking forward, we prefer to use a vertical line dropped from the anteriormost aspect of the lower lip to measure the adequacy of chin projection during facial analysis.
- Analysis should not replace good surgical judgment but should be used to enhance it by providing a reliable guideline in surgical planning that eliminates oversights and subjective variations.
- Alloplastic chin implants are best used for treating minor to moderate degrees of horizontal deficiency. Only a minimal correction of vertical deficiency may be achieved with an implant.
- Precise pocket dissection and attention to proper midline and vertical placement of a chin implant are required for a favorable result.
- If a small (less than 2 mm) amount of augmentation is required and surgical treatment is not desired or not possible, soft tissue fillers may have a role in treatment.

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Management of the Chin in Rhinoplasty Patients

S. Anthony Wolfe ▪ Thaddeus S. Boucree

Unquestionably, it is generally considered unethical to suggest to a patient to have a surgical procedure in an area of the body other than that of the patient's "area of concern." In other words, when a patient comes in for a consultation about her nose, it is not acceptable for the surgeon to shift the conversation to ask whether she would like to have something done about her small breasts at the same time.

However, the opposite is the rule with regard to facial surgery. An aesthetic face must have balance and symmetry. Virtually all surgeons who perform a rhinoplasty believe it is acceptable to point out to a patient that the result of a rhinoplasty might be enhanced if something were done to the chin at the same time, usually enlargement, but on occasion, reduction.[1,2] Patients are not offended by this suggestion, as they might be at the mention of a totally different area of the body.

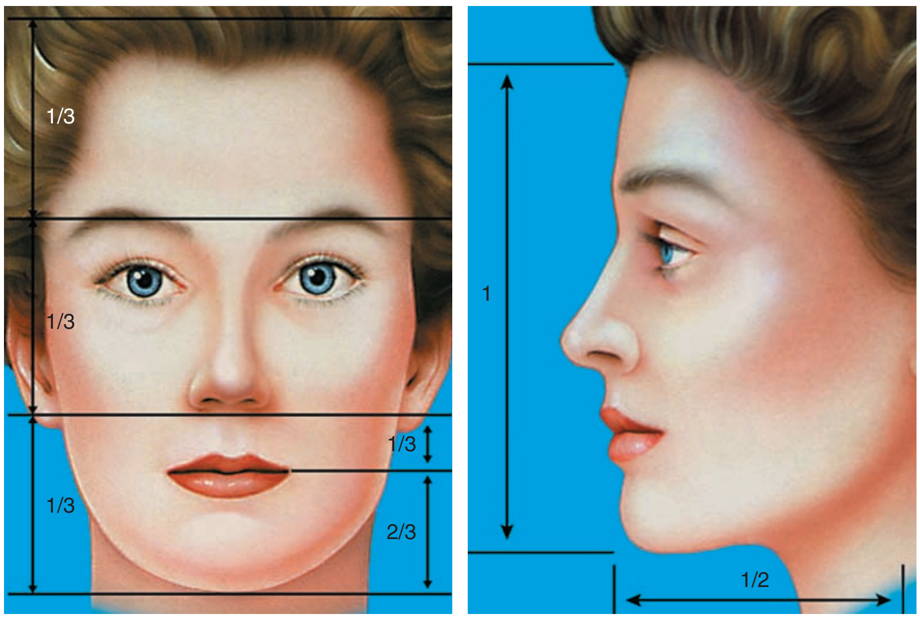
Most patients intuitively understand, as do their surgeons, that the result of a rhinoplasty will be improved if the patient's chin is put in proper balance with the rest of the face.

It is not the purpose of this chapter to go into exhaustive analysis of cephalometric analysis or dental occlusion. Some of the patients we will show have undergone orthognathic surgery, and numerous other sources are available that discuss jaw surgery and its proper indications in great detail.[1,3,4]

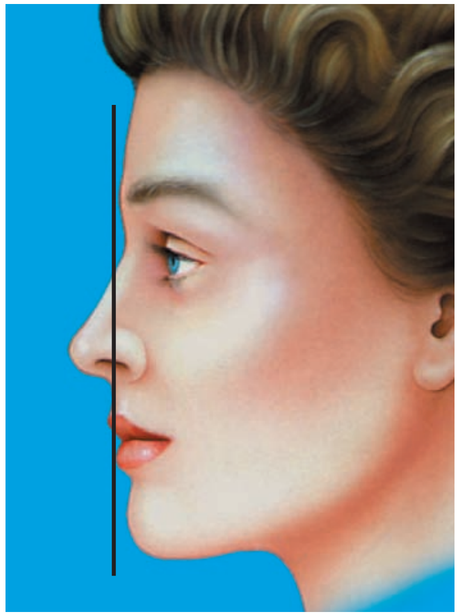
HISTORY

Hofer,[5] a German surgeon, was apparently the first to propose horizontal osteotomy of the mandibular symphysis, with advancement of the lower fragment for microgenia. He reported the operation on a cadaver in 1942. The first written reference to a genioplasty was in 1957 by Gilles and Millard in *The Principles and Art of Plastic Surgery.*[6] Gilles performed a "jumping" genioplasty through an external approach many years before the publication of this book, possibly in the early 1950s. The first intraoral approach was described by Trauner and Obwegeser in 1957.[7]

ANALYSIS OF CHIN POSITION



Attractive faces can be either slightly convex or concave.[8-10] A balanced face, in either frontal or lateral view, can be broken into equal thirds (trichion to brow, brow to anterior nasal spine, anterior nasal spine to pogonion).[9,11-13] The lower third should be divided into one third from the anterior nasal spine to the stomion, and two thirds from the stomion to the pogonion.[12] If the oral commissure to the lowest point of the chin is significantly greater or less than two thirds of the lower facial third, the face will be in imbalance.



The lateral view is the most important view for determining chin position. The anterior point of the chin should be at or behind a vertical line drawn from the most anterior position of the lower lip.[14,15] A proper clinical photograph is essential, and the patient must be instructed to position his or her head appropriately (see Chapters 5 and 7). The patient should be sitting comfortably on a stool and is instructed to look straight ahead. Positioning the patient with the Frankfort horizontal plane (infraobitale to external auditory meatus) is a mistake, because it assumes that the external auditory meatus is in proper position. If the ears are low, the chin will be positioned in a spuriously posterior position.

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In female patients in particular, the point of the chin should not be placed anterior to this vertical drop line.[16] Other methods of determining ideal chin position include drawing the Rickett line, drawn from the tip of the nose to the chin prominence. Forehead projection is important to overall facial projection, but it is better to decide on chin position relative to the upper lip, not the forehead.

Forehead projection is important to overall facial projection, but it is better to decide on chin position relative to the upper lip, not the forehead.

ALTERING THE SIZE AND SHAPE OF THE CHIN

A chin implant is perfectly appropriate if the patient's only problem is mild retrogenia. Placing alloplastic implants is the approach used by most rhinoplasty surgeons, because it is easy to perform and provides consistently good results. Joseph Safian,[17] who was trained by Jacques Joseph, returned to the United States in the 1930s and, like his teacher, began using carved ivory implants for the chin. When he began to have problems obtaining ivory, he switched to silicone rubber, and this represented the first use of chin implants in the United States.[18] Silicone implants are still widely used. Other alloplastic materials including methylmethacrylate and Medpore are also widely used (as was Proplast, until it was taken off the market). We do not have a preference for any of these materials, because we use none of them.[19-21]

We are advocates of the *osseous genioplasty* because of its simplicity and versatility.[5,22-24] In short, with one procedure, a variety of the chin deformities can be corrected.[7] If the surgeon performs only chin implants, surgical corrections are limited to one type of pathology—a posterior positioned chin.

Mastering a simple procedure such as a horizontal osteotomy of the mandibular symphysis can enable the surgeon to correct chins that are too large, deviated to one side, or too short, whereas a chin implant can only correct mild retrogenia.

OPERATIVE TECHNIQUE

Genioplasty

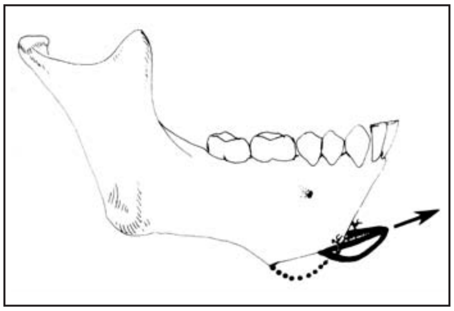
Genioplasty can be performed under local anesthesia with inferior alveolar nerve blocks; the bone can be cut painlessly, but one must infiltrate the submental musculature copiously with local anesthetic to avoid causing pain and muscle spasm when the symphyseal fragment is grasped and advanced. It is certainly much easier for both patient and surgeon if the procedure is performed under general anesthesia,[23] and it is much safer; generous amounts of copious irrigation could be aspirated in a heavily sedated patient. If concomitant nasal surgery is performed, oral intubation is essential.[25]

Good power equipment for bone surgery is essential.[23,25] We prefer an electric system over one powered by compressed air because of superior torque. Both the Aesculap and Stryker systems provide excellent interchangeable headpieces for a drill, a reciprocating saw, and an oscillating saw. As in all bone surgery, adequate irrigation, either built into the system itself or provided by an assistant, is essential to avoid burning bone.[1]

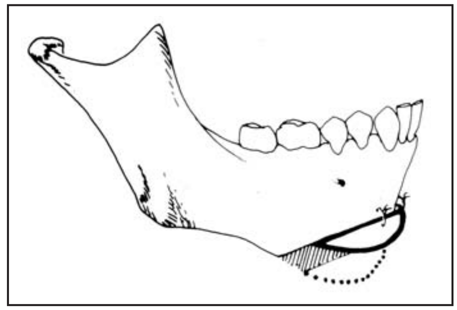
In most cases, the surgical approach is through a lower buccal incision. The incision is made from cuspid to cuspid, 3 to 4 mm below the lowest limit of attached gingiva, initially through the mucosa, then angled back upward so the upper mucosal flap contains a minimal amount of mentalis muscle. It must be remembered that all muscle superior to the incision will be denervated. If significant amounts of the muscle are denervated or damaged, this may result in lower incisive show. The surgery then proceeds entirely subperiosteally. Dissection is carried inferiorly using sharp periosteal elevators to the lower border, and laterally until the mental nerves, usually located between the first and second bicuspids, have been visualized. Once they have been identified, dissection can be carried laterally beneath the nerves onto the parasymphyseal area.[20]

The midline is scored vertically with the reciprocating saw. The surgeon should be able to see both of the patient's eyes, to establish that a horizontal line perpendicular to this initial scoring is parallel to a plane between the lateral canthi. Marking the proposed osteotomy line on the bone with a pencil is a good idea.[20] To obtain a proper inclination of the saw, the patient's head should not be in a doughnut, and the neck should be moderately extended.

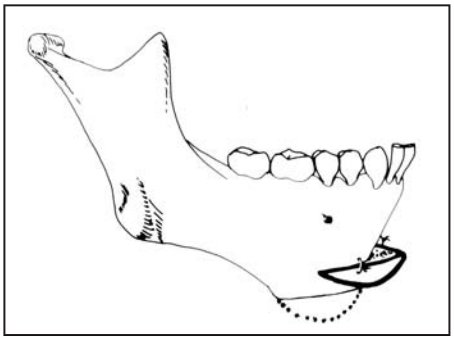
If possible, the entire horizontal osteotomy is performed with the oscillating saw. The surgeon should not do a partial osteotomy and then try to downfracture the symphyseal segment, because there will often be bone spurs that remain on the lower fragment and interfere with advancement. If the lower segment is not completely separated with the oscillating saw, the reciprocating saw can be inserted to cut cleanly through the posterolateral border of the symphyseal segment.



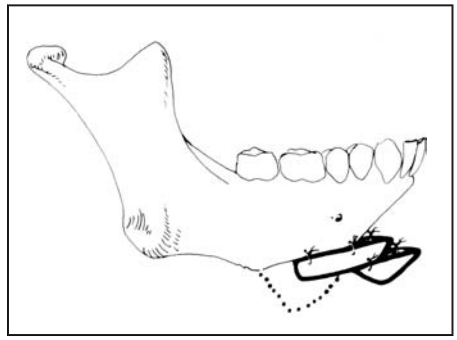
Sliding genioplasty



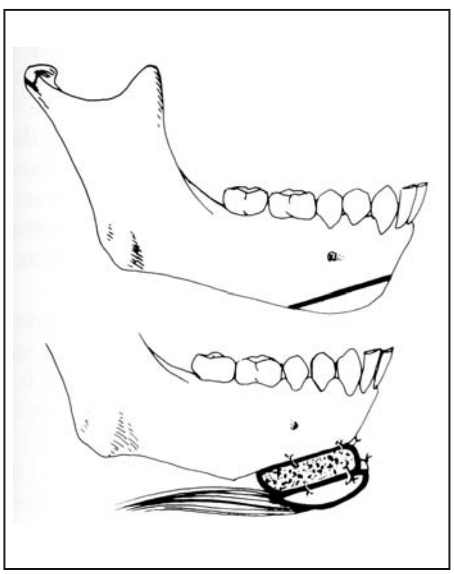
Reduction genioplasty



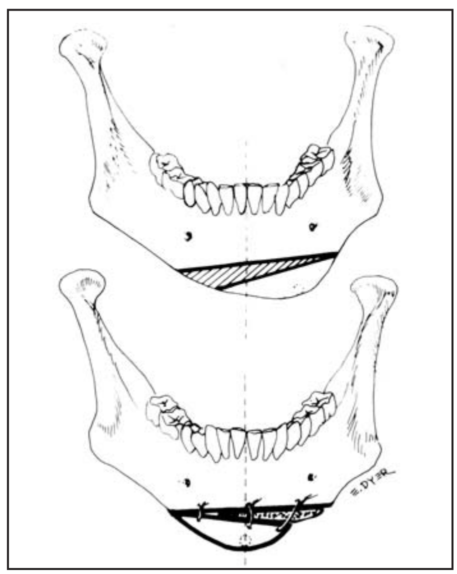
Jumping genioplasty



Two-tier genioplasty



Genioplasty with interpositional bone graft



Centering genioplasty

Once this horizontal osteotomy has been performed, the surgeon can perform the following:

- Advance the lower segment (sliding advancement)
- Remove another superior strip of the bone to shorten the chin vertically, removing 6 mm below the mental foramen to avoid damaging the mental

nerve; the nerve runs inferior within the mandible, before it ascends to exit through the mental foramen

- Interpose a bone graft between the basilar segment and the upper symphyseal segment to lengthen the chin
- Move the basilar segment to one side to correct a laterogenia
- Elevate the basilar segment completely up on top of the upper symphyseal segment, which simultaneously shortens and advances the chin (jumping genioplasty)

Interosseous fixation can be performed with stainless steel wires, lag screws, or miniplates and screws. It is essential that the fixation be absolutely rigid.

Rarely if ever is there an indication to move the basilar segement posteriorly. This may cause loss of the labiomental crease, and a flat, unattractive chin.[21]

If there is a deep labiomental crease, lengthening the chin may soften it. If the patient has a chin that appears large and protrusive, the chin may be shortened by removing an intermediate strip, as mentioned earlier, but usually the symphyseal segment should be advanced slightly to maintain a labiomental crease.[21] A large, ptotic chin may also have thick, redundant soft tissue that may require skin excision in the cervicomental junction.

Patients With Previously Placed Chin Implants

If the implant is causing no problems and the patient is happy with the result, there is no need to do anything further to the chin.[26] However, if there is a problem with the implant (its position has shifted, there has been significant erosion into underlying bone with loss of projection, or simply an inadequate result), we recommend removing the implant and performing the appropriate type of osseous genioplasty.[19,21,27]

Rhinoplasty

Genioplasty is performed first, because the rhinoplasty must be in balance with the new chin, not the old one.

Techniques of rhinoplasty are dealt with exhaustively and superbly elsewhere,[28] but we will describe in brief our current approach.

Closed Versus Open Approach

Closed Approach The senior author learned closed rhinoplasty techniques from his two teachers, Drs. Millard and Tessier, and for the first half of his career used only this approach. Primary rhinoplasties performed using a closed approach were primarily those of reduction: shortening the nose and providing tip rotation by appropriate caudal septum trimming, removing a dorsal convexity, and reducing the alar cartilages by estimating their dimensions and removing the cephalic half or more. Septoplasty, submucous resection of the septum, and an occasional trim of a turbinate were done when patients complained of breathing problems. Perhaps because of a tendency to be overly cautious in resection of the dorsal septum, there was a revision rate of approximately 10%, which almost always involved trimming down the underresected and noticeable septum in the supratip area. These were cases that all looked good on the table, and the problem arose because the upper lateral cartilages were not stabilized to the septum and postoperatively sank below the anterior septal border, leaving a noticeable septal projection. When tip projection was inadequate, various types of shield grafts were inserted through alar marginal incisions that led into a separate subcutaneous pocket in the nasal tip.

Secondary rhinoplasty performed by other surgeons occasionally were for pollybeak deformities but more often involved bone (usually cranial) or septal grafts to correct saddlenose deformities, and conchal grafts to the tip; all slid into pockets created through one or both nostrils.

Open Approach In the late 1980s, because of dissatisfaction with the results that were being obtained in the cleft lip rhinoplasties, we began using an open approach. A columellar base incision was used, because most of the patients already had a scar in this area. We have continued to use this incision despite the fact that most advocates of open rhinoplasty (Gunter, Tebbets, Guyuron, Rohrich, Daniel, Gruber) use a broken line or stair-step transcolumellar incision or some variation of the two.[29]

As mentioned earlier, advocates of an open approach are correct in stating that the midcolumellar incision heals nicely in most patients, but having looked at multiple presentations over the years, scars can be seen on some of their images, albeit faintly. Some patients have a preexisting crease at the columellar-labial junction and are therefore ideal candidates for this incision. The columellar-labial junction in a bearded male is at the junction of the glabrous thinner skin over the columella and the thicker hair-bearing skin of the upper lip. The worst candidate for a collumellar base incision would be a patient with a very obtuse nasolabial angle and a broad separation of footplates of the medial crura, if these

structures are going to be left undisturbed. In these cases a midcolumellar incision is preferred. If the nasolabial angle is to be made more acute and the footplates narrowed, then the balance shifts back to the columellar base incision. Concerns have been expressed about the vascularity of the columella with this lower incision, but we have not seen a single instance of circulatory ischemia in more than 500 cases, even when the incision is closed under considerable tension after major increases in tip projection.

We have shifted almost entirely to open rhinoplasty except in cases where patients will not accept an external incision (which is quite rare). The open approach is technically more demanding: new instrumentation and a whole new set of skills need to be developed to stabilize the various cartilaginous structures as they are trimmed, fixed, and have shape-altering sutures placed. The number of various grafts and sutures that have been described by those advocating an open approach is bewildering at first, but with time one becomes comfortable with a number of them. It is a challenge for young surgeons learning to perform open rhinoplasty procedures to first determine the ideal position of the alar cartilages. A model developed by Gruber has been helpful.

The overwhelming advantage of the open techniques is that it gives control, almost microsurgical precision, and stability.

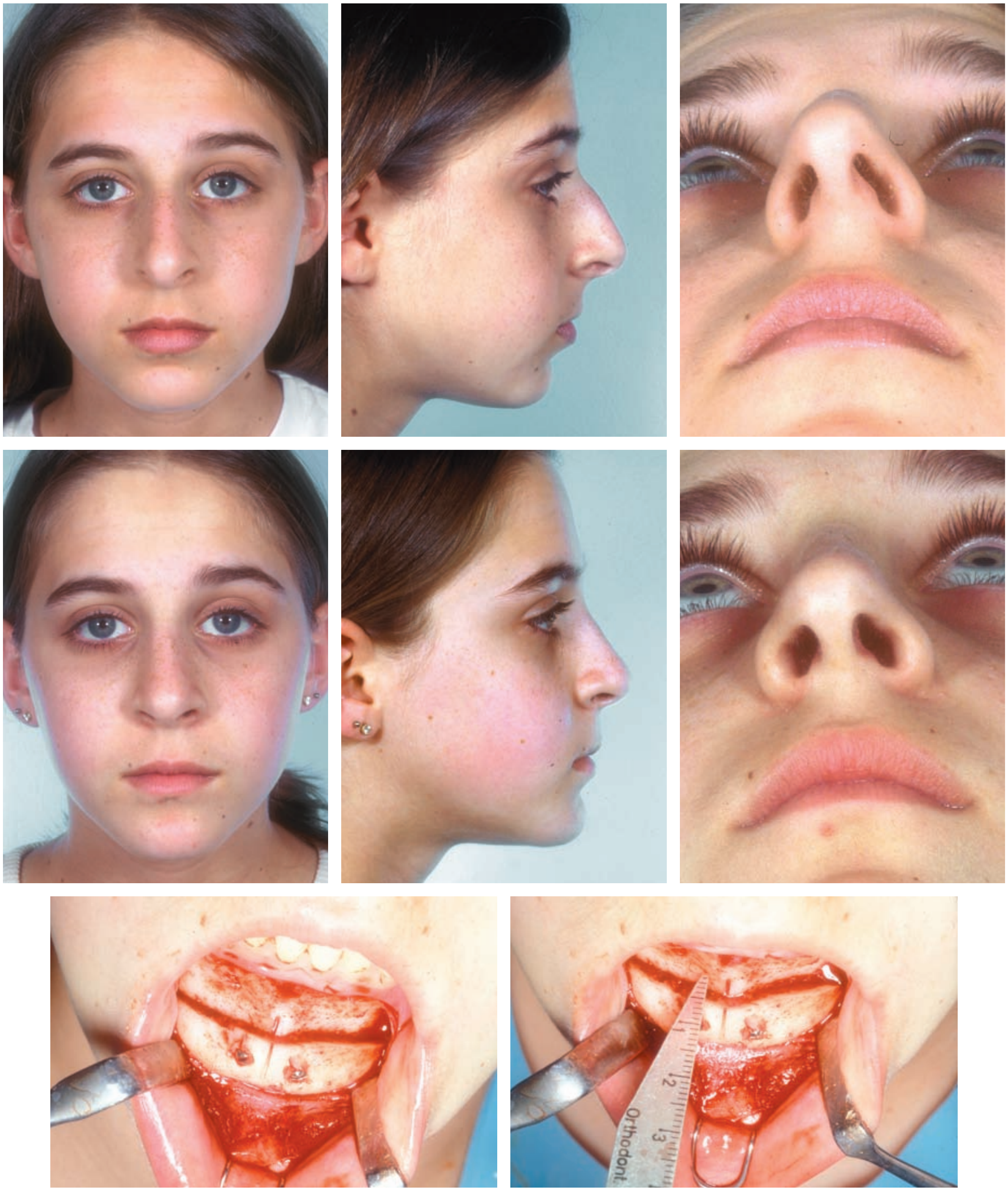
Columellar strut grafts can maintain the alar cartilages in a precise and stable relationship to the caudal septum. Spreader grafts give further stability and greater control of the deviated septum. The approach to the septum from above, is clearly superior to the old Killian intranasal approach. This approach allows separation of the upper lateral cartilages. With the stability provided by spreader grafts, our reoperation rate on the supratip septum has dropped to zero. In addition, the frequent use of spreader grafts stabilizes the upper lateral cartilage–septum area. Many of our patients have significantly improved nasal breathing, which we have attributed to the use of a variety of small grafts to the alar cartilage.

CASE ANALYSES

The cases shown here reflect surgeries performed over a 38-year period, and all patients had a variety of the chin problems that were managed with a number of different types of osseous genioplasties. A few of the patients could have been treated equally effectively with alloplastic chin implants, which we do not use. Both closed and open rhinoplasty approaches were used.

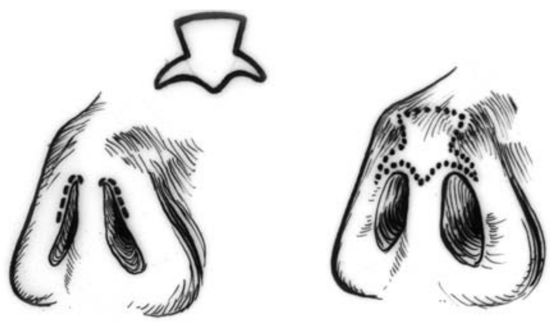
This patient had had a silicone chin implant placed several years previously and was displeased with the results. She is shown before and after removal of the chin implant and performance of a jumping genioplasty. It was not the silicone implant that was at fault here but its improper use. This patient actually has a long retroclined chin and needed shortening as well as advancement, which cannot be accomplished with an implant.

It has been said that an open rhinoplasty performed through a columellar base incision will cause loss of the gentle little curve between the base of the columella and the lip. This has not been our experience. If that little curve is present beforehand, it can be preserved. The patient shown here is not the best candidate for a columellar base incision because she has such widely separated medial crura; she is shown approximately 1 month postoperatively, with the scar still visible. The junctional area of the lip and columella does not appear to have been changed. A similar result could very likely have been achieved with a closed approach, but at the time of this procedure we preferred the open approach because of the greater precision, control, and stability that are possible.



This patient could have undergone either open or closed rhinoplasty, and either a chin implant or genioplasty could have been used with equal results. Her surgery was performed in 1996, and a closed rhinoplasty and genioplasty were used. The operative photograph shows a 6 mm advancement of the basilar segment, fixed with two 2.0 mm lag screws. Further advancement could have been achieved but would not have been equally aesthetically pleasing. If we had performed this patient's surgery after 2006, an open approach would have been used for rhinoplasty.

In this patient a fairly minimal rhinoplasty was performed through a closed approach in 1979. The transformation of the patient's appearance is more the result of the genioplasty. The postoperative appearance of the chin is ideal, with a straight line connecting the upper and lower lip and the anteriormost chin point (pogonion), and with the anteriormost chin point resting slightly behind the lower lip.



This patient had a variety of deformities (inverted-V deformity, pollybeak deformity, pinched tip) after a closed rhinoplasty performed elsewhere. A closed approach was used for the secondary procedure in 1983, with trimming of the septum in the supratip area, nasal bone osteotomies, a dorsal graft using septal cartilage, and an extended shield graft to the tip. As in the previous patient, much of the improvement was the result of the genioplasty. Many patients with such tip grafts, when seen a decade or more later, have had a deterioration of the nasal tip and thinning of the overlying skin. Today, using an open approach, these problems can be avoided.[28]

This 60-year-old woman is shown before and several years after a closed rhinoplasty, meloplasty, submental lipectomy, and sliding genioplasty in 1981. The chin was advanced the maximum amount possible to preserve contact between the anterior border of the upper symphasis and the posterior border of the advanced basilar segment (9 mm). A similar result could not have been obtained with a chin implant because of the tightening of the geniohyoid musculature that has occurred. A critical analysis of the result with the nose shows that the nasion is a bit high in the postoperative photograph. If this patient were being treated today, we would use an open approach for rhinoplasty, because it is much easier to contour the frontonasal junction with a high-speed burr under direct vision.

This patient had a previous rhinoplasty, with placement of a Proplast implant around the alar base and nasal spine areas, and a silicone chin implant, but she was not pleased with the result. She is shown 13 years after a LeFort I–type osteotomy and iliac bone grafting (performed largely for the purpose of dental restorations), removal of the Proplast implant, removal of the chin implant with a lengthening genioplasty and interpositional iliac bone, and an iliac bone graft to the nose. The operative photographs show the patient with the foreign material removed and rigid fixation of the genioplasty with 2.0 mm titanium miniplates.

The daughter of the previous patient (shown on p. 762) is shown before and after a closed rhinoplasty and advancement genioplasty. Structurally, she would not have been a good candidate for a chin implant.

This patient is shown before and 14 years after three separate operations:

1. Maxillary advancement (LeFort I), mandibular setback (sagittal split), and reduction genioplasty
2. Reduction of the frontal bone and supraorbital ridges, closed rhinoplasty with a small cranial bone graft for lengthening the nose and softening of the nasofrontal angle
3. A second LeFort I maxillary advancement

The first two operations were performed in 1991. The patient returned in 2005 while under orthodontic treatment for a mild return of class II malocclusion. A second LeFort I maxillary advancement was performed, leaving her with satisfactory occlusion.

This patient had a complex malocclusion with a deviation of her chin point to the right and a cant of the labial commissure. The malocclusion had been corrected with orthodontics alone. Her nose was deviated to the left. She is shown after an open rhinoplasty (dorsal reduction, osteotomies, spreader grafts, columellar strut, and septal repositioning), a genioplasty with slight vertical reduction (removal of a transverse 5 mm segment above the basilar segment, which was placed as an onlay graft over the maxilla), and centering of the chin by a 6 mm movement to the left (advancement by 6 mm).

This patient had an open rhinoplasty with minimal dorsal reduction, no osteotomies, columellar strut, and interdomal and transdomal tip sutures. A sliding genioplasty with 5 mm advancement and minimal liposuction of the neck and submandibular areas were also performed.

Preoperatively, this patient's nose was deviated to the right. She is shown after an open rhinoplasty with a columellar base incision (note preservation of the soft curve at the nasolabial junction), dorsal reduction, osteotomies, spreader grafts, and columellar strut, a sliding advancement genioplasty of 8 mm, and extensive liposuction of the anterior neck and submental areas (without a face lift).

This 17-year-old girl had a prior rib graft for congenital temporomandibular joint ankylosis. Her occlusion and mouth opening is now satisfactory. This patient's primary complaint was that her nose was too large. Her face lacked balance, and she had a deficiency of vertical height. We felt that by lengthening the chin and removing buccal fat pads, her face would have better symmetry. Postoperative photos show her after a lengthening genioplasty (10 mm) with interpositional calvarial bone grafting and rigid fixation with 2.0 mm miniplates and excision of bilateral buccal fat pads. She has better nasofacial balance.

This patient had bilateral sagittal split osteotomies, a LeFort I maxillary advancement, and an advancement genioplasty, which was performed elsewhere. She was enormously bothered by the lower incisive show. This is an uncommon event after genioplasty, but can occur and is difficult to correct. It is usually a result of making the incision and denervating the mentalis muscle. The patient had a fascia lata sling to the lower lip, which improved her symptoms.

KEY POINTS

- Most patients intuitively understand, as do their surgeons, that the result of a rhinoplasty will be improved if the chin is put in proper balance with the rest of the face.
- Positioning the patient with the Frankfort horizontal plane is a mistake, because it assumes that the external auditory meatus is in proper position. If the ears are low, the chin will be positioned in a spuriously posterior position.
- Forehead projection is important to overall facial projection but it is better to decide on chin position relative to the upper lip, not the forehead.
- Mastering a simple procedure such as a horizontal osteotomy of the mandibular symphysis can enable the surgeon to correct chins that are too large, deviated to one side, or too short, whereas a chin implant can only correct mild retrogenia.
- Rarely if ever is there an indication to move the basilar segment posteriorly. This may cause loss of the labiomental crease and a flat, unattractive chin.
- Genioplasty is performed first, because the rhinoplasty must be in balance with the new chin, and not the old one.
- The overwhelming advantage of the open rhinoplasty technique is that it gives control, almost microsurgical precision, and stability.

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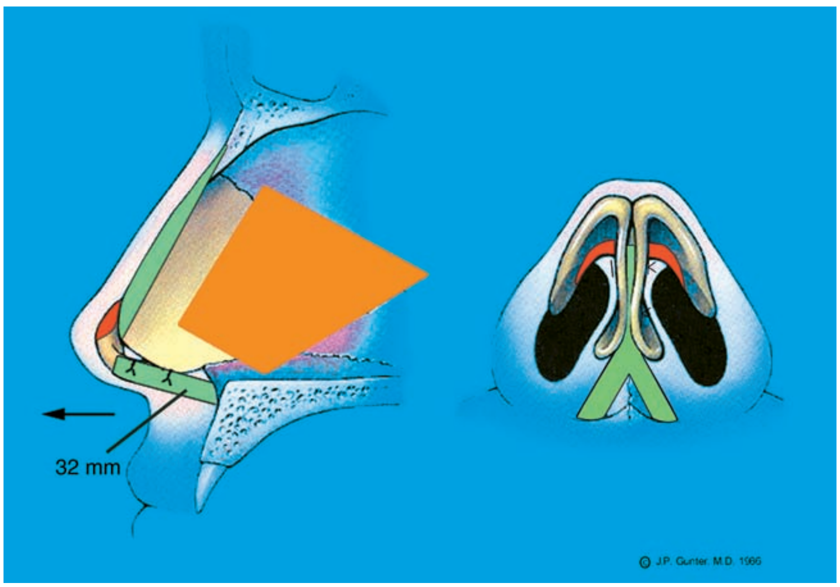
PART EIGHT

Secondary Rhinoplasty



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Open Approach in Secondary Rhinoplasty

C. Spencer Cochran ▪ Jack P. Gunter

Rhinoplasty is generally considered one of the most difficult procedures in cosmetic surgery. The reported incidence of postoperative nasal deformities requiring secondary rhinoplasty varies from 5% to 12%.[1] Deformities arising from a prior rhinoplasty can range in severity from mild asymmetry of the nasal tip or dorsum to severe distortion and collapse of the osteocartilaginous framework. Regardless of the severity, the causes of postoperative rhinoplasty deformities are most frequently related to (1) displacement or distortion of anatomic structures, (2) inadequate surgery resulting in underresection of the nasal framework, or (3) overresection from overzealous surgery. Success in secondary rhinoplasty therefore relies on an accurate clinical diagnosis and analysis of the nasal deformities, a thorough operative plan for each abnormality, and meticulous surgical technique.

Success in secondary rhinoplasty relies on an accurate clinical diagnosis and analysis of the nasal deformities, a thorough operative plan for each abnormality, and meticulous surgical technique.

This chapter is adapted from Gunter JP, Rohrich RJ. External approach for secondary rhinoplasty. Plast Reconstr Surg 80:161-174, 1987.

BACKGROUND

Reconstruction of the osteocartilaginous framework is the foundation for consistent aesthetic and functional results in secondary rhinoplasty. Septal cartilage is generally considered the preferred graft material for most applications in rhinoplasty, but secondary rhinoplasty frequently necessitates alternative sources of graft material in patients with severe structural deformities of the nasal framework or insufficient amounts of septal cartilage.[2,3] In some cases, auricular cartilage may be suitable; however, rib cartilage provides the most abundant source of grafts and has proved to be the most reliable in our hands for the correction of major secondary deformities.

Reconstruction of the osteocartilaginous framework is the foundation for consistent aesthetic and functional results in secondary rhinoplasty.

INDICATIONS AND CONTRAINDICATIONS

Although adequate results are possible with the closed approach in some circumstances, the limited dissection and exposure offered by this technique often does not allow accurate assessment, intraoperative diagnosis, and appropriate treatment of complex anatomic problems. We therefore prefer to treat most secondary rhinoplasty deformities using the open approach to help ensure consistent aesthetic and functional results.

We prefer to treat most secondary rhinoplasty deformities using the open approach in an effort to ensure consistent aesthetic and functional results.

Some patients are not candidates for open rhinoplasty. This includes patients who have limited soft tissue extensibility and those in whom viability of the soft tissue envelope would be jeopardized by diminished blood flow with the open approach.

Assessment of a patient's psychological status and stability are essential components of the preoperative evaluation. It is estimated that 5% of patients seeking cosmetic surgery have body dysmorphic disorder (BDD), which is a preoccupation with a slight or imagined defect of their physical appearance that leads to significant disruption in daily function.[4] Patients with a legitimate cosmetic or functional concern need to be distinguished from patients who are abnormally overconcerned about minor imperfections of their nose.

PREOPERATIVE ASSESSMENT AND PLANNING

A thorough nasal analysis and precise anatomic diagnosis of each deformity are key steps to achieving optimal results in secondary rhinoplasty. Preoperative evaluation begins by defining the deformity based on a detailed history, physical examination, and complete aesthetic facial and nasal analysis.

Common Postoperative Rhinoplasty Deformities

Dorsum	Tip
Overresection	Asymmetry
Dorsal irregularity	Alar collapse
Pollybeak deformity	Alar retraction
Inverted-V deformity	Hanging columella
Saddle deformity	Retracted columellar-labial angle
	Overrotation of the tip

A thorough nasal analysis and precise anatomic diagnosis of each deformity are key steps to achieving optimal results in secondary rhinoplasty.

The nose should be analyzed from top to bottom. Starting superiorly, the height, width, and symmetry of the dorsum are noted. The nasofrontal angle normally begins at the supratarsal crease and may be lower in patients with an overresected dorsum. The contour of the dorsum is assessed for irregularities. The width of the bony pyramid and upper lateral cartilages is inspected for asymmetry, collapse, and the presence of an inverted-V deformity. The supratip area is evaluated for the presence of a pollybeak deformity or absence of an appropriate supratip break. Nasal tip projection and rotation are evaluated. The lower lateral cartilages are assessed for symmetry, width, position, and symmetry of the tip-defining points. The alar rims are inspected for collapse or retraction. The columella is examined for increased or decreased show. The columellar-lobular and columellar-labial angles are evaluated to determine the desired angulation. The internal nasal examination assesses patency of the nasal valves, the position and integrity of the septum, and the state of the turbinates.

After a patient is deemed a good psychological candidate and the deformities are defined, goals of the surgery are established and an operative plan formulated for each abnormality. The operative goals are individualized for each patient according to the deformity. Goals may include augmentation of the dorsum, straightening of a dorsally deviated septum, lowering of the supratip area, correction of

tip asymmetry and alar collapse, or decreasing columellar show, among others. If the existing osteocartilaginous framework is underresected, the amount and location of further reduction are determined. If the nasal framework has been overresected, the missing tissues and areas requiring augmentation are determined. Secondary surgery is usually deferred until at least 12 months after the previous rhinoplasty to allow resolution of postoperative edema and maturation of scar tissue.

Operative goals are individualized for each patient according to the deformity.

Key components of operative planning in secondary rhinoplasty are assessment of the grafting requirements and identification of potential graft sources. Structural deformities from previous procedures often require significant numbers of grafts such as spreader grafts, lateral crural strut grafts, and dorsal onlay grafts.[2] We prefer autologous cartilage for nasal framework replacement. Successful results with irradiated homologous rib cartilage have been reported,[5] but problems with infection, absorption, and warping limit its routine use in secondary rhinoplasty.

Septal cartilage is generally the preferred graft material in both primary and secondary rhinoplasty. The integrity of the nasal septum, and thus its availability for use as cartilage grafts, can be assessed during the office consultation by gentle palpation with a cotton-tipped applicator. Septal cartilage offers several advantages. A large amount of septal cartilage and septal bone can be harvested from the same operative field without the morbidity of an additional donor site. Compared with auricular cartilage, septal cartilage is more rigid, provides better support, and has no convolutions. It is preferably used as a columellar strut, spreader grafts between the upper lateral cartilages and the septum, and lateral crural strut grafts to support or replace parts of the lower lateral cartilage complexes. When a sufficient quantity is available, it can be used as a dorsal onlay graft for minimal amounts of dorsal augmentation.

Severe deformities or a paucity of available septal cartilage requires an alternative source of graft material. The ear provides a modest amount of cartilage for nasal reconstruction.[6] With a posterior auricular approach, the amount of harvested conchal cartilage can be maximized without compromising ear protrusion if sufficient cartilage is preserved in three key areas: (1) the inferior crus of the antihelix, (2) the root of the helix, and (3) the area where the concha cavum transitions into the posteroinferior margin of the external auditory canal. A vertical incision is created on the posterior aspect of the ear, and dissection is car-

ried down through the perichondrium. A 27-gauge needle dipped in methylene blue is percutaneously placed every half centimeter along the inner aspect of the antihelical fold to tattoo the cartilage along the planned excision path to maximize the amount of harvested cartilage while ensuring that sufficient antihelical contour is maintained. Dissection proceeds along both the anterior and posterior surface of the conchal bowl. A kidney bean–shaped piece of conchal cartilage is harvested, preserving sufficient cartilage at the three key areas for support.

Because of its flaccidity and convolutions, auricular cartilage is best used when these characteristics are desired. It is usually employed for reconstruction of the lower lateral cartilage complex, for small onlay grafts, or for placement in the columella to provide tip support. However, it is a second choice to septal cartilage because of the inherent difficulty in obtaining and maintaining the desired shape and contour. Although initial results of dorsal augmentation with auricular cartilage are often satisfactory, surface irregularities can become apparent with the passage of time. Furthermore, auricular cartilage's irregular contour and limited supply often preclude it use.

Autologous rib cartilage has been our graft material of choice for secondary rhinoplasty when sufficient septal cartilage is not available, because it provides the most abundant source of cartilage for graft fabrication and is the most reliable source when structural support or augmentation is needed.[2,7]

Autologous rib cartilage has been our graft material of choice for secondary rhinoplasty when sufficient septal cartilage is not available.

Various types of alloplastic materials have been used in rhinoplasty, including solid silicone, high-density porous polyethylene (Medpor), and expanded polytetrafluoroethylene (Gore-Tex). Alloplastic materials are easy to use, readily available, and unlimited in supply. Unfortunately, because of their permanent nature, many of these alloplastic materials are fraught with long-term complications such as infection, migration, extrusion, and palpability.[8-11] Thus autologous tissue continues to be our preferred source of grafts.

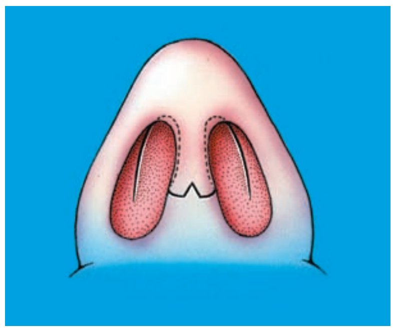
OPERATIVE TECHNIQUE

Although the approach and operative steps and sequence are individualized for each patient, the general steps of open secondary rhinoplasty proceed in the following order: incisions, elevation of the soft tissue envelope, confirmation of preoperative diagnosis and reassessment of grafting requirements, septoplasty/

septal cartilage harvest, dorsal modification, establishment of desired tip projection and reconstruction of the nasal tip complex, osteotomies, final tip cartilage positioning and shaping, wound closure, and application of splints and dressings.

Incisions

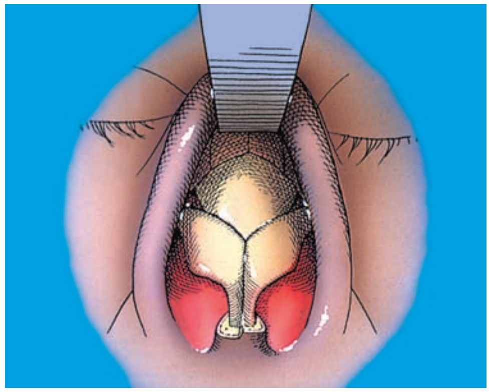
With the patient under general anesthesia, the external nose and septum are injected with 1% lidocaine with 1:100,000 epinephrine. The internal nose is packed with ¼-inch gauze strips soaked in a vasoconstricting medication such as oxymetazoline.



Bilateral infracartilaginous incisions along the caudal edge of the lower lateral cartilages are terminated medially at the narrowest part of the columella and connected with a transcolumellar incision. If the initial rhinoplasty was performed using a closed endonasal approach, an inverted-V or chevron-shaped incision is used. This broken-line closure allows precise wound closure and decreased scar visibility. If the preceding rhinoplasty was performed using an open approach, the same incision is used to minimize scarring. For wide or unattractive transcolumellar scars, the previous scar can be excised; however, resultant shortening of the columellar skin may hinder closure and place excess tension on the incision.

Elevation of the Soft Tissue Envelope

The thin columellar skin is elevated from the caudal edges of the medial crura, and elevation of the soft tissue envelope proceeds toward the domes. Dissection continues over the lateral crura in either a medial to lateral or lateral to medial direction. Care is taken to prevent unnecessary retraction or injury to the soft tissue envelope, particularly the columellar skin, because the blood supply can be tenuous from disruption in prior surgeries. The normal tissue planes are frequently nonexistent, having been replaced with variable amounts of scar tissue. Surgeon should be cautious not to perforate the skin overlying the lower lateral cartilage complexes.



The integrity of the domal segments (when they are present) needs to be preserved as dissection continues over the tip, because all usable portions of the lower lateral cartilages facilitate reconstruction of the tip complex. Once the tip is exposed, dissection continues over the dorsal septum and upper lateral cartilages. A Joseph elevator is used to lift the periosteum off the nasal bones superiorly to the level of the nasofrontal angle. Retraction of the undermined area exposes the entire osteocartilaginous framework.

Confirmation of Preoperative Diagnoses and Reassessment of Grafting Requirements

After the soft tissue envelope is elevated from the underlying nasal framework, the nasal cartilages are evaluated and correlated with the preoperative diagnosis. The extent of the upper lateral cartilages and nasal tip deformity are determined, and cartilages that are displaced or distorted by scar tissue are dissected free. A crucial step in the operative sequence is the assessment of adequate tip projection, because reduction or augmentation of the dorsum should be performed with the final tip projection in mind.

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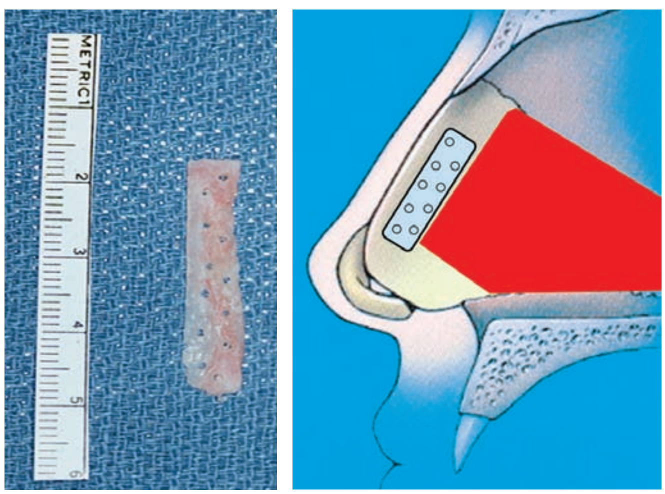
Silicone sizers are useful for assessing graft requirements. These can be employed to estimate the shape and size of the columellar strut and dorsal onlay graft when indicated. The sizers are prefabricated by the surgeon from molds of anatomically shaped dorsal onlay grafts and columellar struts carved in a paraffin wax block in an assortment of shapes and sizes. Room temperature vulcanizing silicone is mixed, poured into the molds, and left for 24 hours to polymerize before they are

trimmed to their final form. The sizers are then sterilized and placed in the operative field. With a columellar sizer in place, various dorsal sizers are placed on the dorsum, and the skin is redraped until the desired combination is determined.

Septal Cartilage Harvest/Septoplasty

If septal work is required, we advocate approaching the septum from above after the upper lateral cartilages are divided from the septum. The upper lateral cartilages can be freed from the dorsal septum after submucopericondrial tunnels are created bilaterally using an elevator, beginning at the septal angle.

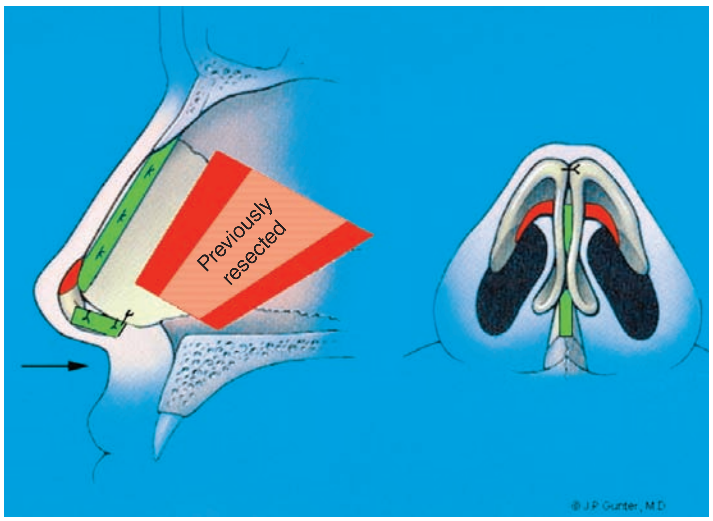
The mucoperichondrium is elevated on one side, and the appropriate septal modification or septal cartilage harvest is performed. If septal cartilage is to be harvested, care is taken to preserve an L-shaped septal strut measuring at least 10 mm in width. If the caudal septum is deviated or dislocated from the maxillary crest or nasal spine area, it is reduced to the midline and fixated with a figure-of-eight suture. It may be necessary to separate the medial crura to gain better exposure, but their attachment to each other aids in supporting the tip and must be reestablished before the end of the operation.



The integrity and strength of the septal L-strut are often compromised because of previous surgery. If the septal L-strut has been weakened or overresected, dorsal spreader grafts placed along either side of the septum provide stabilization. Similarly, a weak L-strut can be straightened and strengthened by a piece of the bony septum that is sutured along the deformed segment after suture holes are created in the bone with a 1 millimeter drill bit.

Spreader Graft Placement

After the desired tip projection is estimated and septal work is completed, the cartilaginous-bony dorsum is evaluated and augmentation or reduction of the dorsum is performed if needed. The bony dorsum is usually reduced with a rasp, and remaining contour irregularities can be smoothed using a drill with a coarse diamond burr. The dorsal septum and upper lateral cartilages are then trimmed to the desired height with a scalpel or sharp angled scissors.



Frequently, secondary rhinoplasty patients require placement of dorsal spreader grafts. Spreader grafts are usually paired, longitudinal grafts placed between the dorsal septum and the upper lateral cartilages. They are used to straighten a deviated dorsal septum, improve dorsal aesthetic lines, correct upper lateral cartilage collapse, and reconstruct an open roof deformity.[12]

The length and shape of spreader grafts vary depending on the indication. They can extend above the level of the dorsal septum to slightly augment the dorsum, or they can extend caudally beyond the septal angle as extended spreader grafts to lengthen the nose. The grafts should be sutured to the septum before the upper lateral cartilages are reapproximated to the septum–spreader graft complex. Failure to reapproximate the upper lateral cartilages to the dorsal septum can cause an inverted-V deformity and contribute to internal valve obstruction.

Dorsal Augmentation

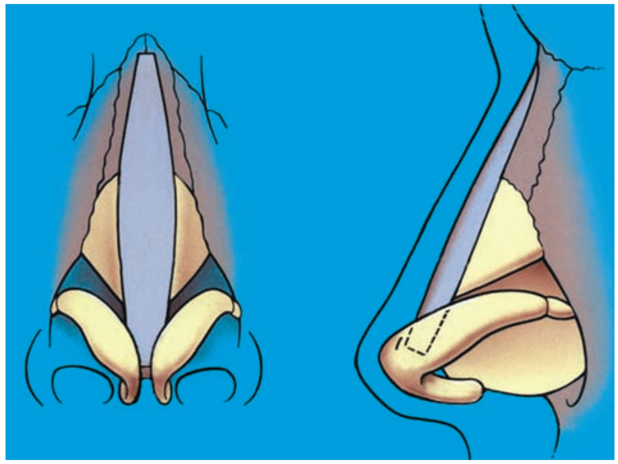
With the midvault reconstructed, the dorsum can be augmented as necessary. Autologous rib cartilage is our graft material of choice for dorsal augmentation when sufficient septal cartilage is not available. The dorsum of the nose needs to be prepared to receive the dorsal graft. The recipient bed on the dorsum is made as flat and smooth as possible to provide the greatest surface area for contact with the dorsal onlay graft. A uniform surface of the dorsal recipient bed aids in the graft adhering solidly to the osteocartilaginous framework. This prevents postoperative movement of the graft after healing is complete, which often occurs with grafts placed in soft tissue envelopes. Soft tissue irregularities and scar tissue should be judiciously removed from the undersurface of the soft tissue envelope to prevent overlying irregularities.

Soft tissue irregularities and scar tissue should be judiciously removed from the undersurface of the soft tissue envelope to prevent overlying irregularities.

Soft tissue grafts such as perichondrium or temporalis fascia may suffice for minimal amounts of dorsal augmentation or for camouflaging irregularities of the dorsum. For slight amounts of dorsal augmentation, septal cartilage grafts can be effective provided that adequate cartilage is available. For more significant augmentation, rib cartilage is necessary to construct a dorsal onlay graft.

The major disadvantage of rib cartilage is its tendency to warp. To prevent warping of smaller grafts, we follow the principle of carving balanced cross-sections, originally described by Gibson and Davis[13] and later substantiated by Kim et al.[14]

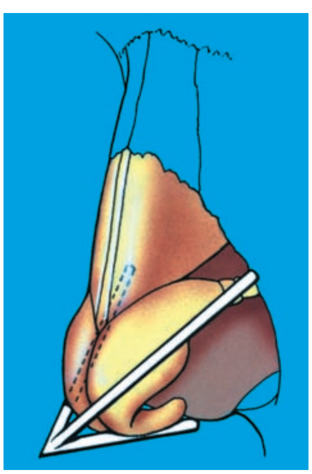
A rib cartilage dorsal onlay graft is carved into the appropriate length and width. The grafts are then placed in their anatomic position to determine whether further shaping is required. Carving proceeds carefully from this point. Usually the grafts are scraped with the sharp edge of a No. 10 blade perpendicular to the graft surface until the exact desired size, shape, and contour are obtained.



Next, the dorsal onlay graft is placed and secured. The cephalic end of the graft is fixated by percutaneous placement of a temporary 0.028-inch smooth K-wire through the graft and into the nasal bones near the nasofrontal angle. This K-wire is removed in the office with a wire twister 1 week postoperatively, when the external splint is removed. Caudally the graft is secured to the nasal dorsum by a suture that passes around or through the graft and through the upper lateral cartilages and nasal septum–spreader graft complex in the area of the septal angle. Any remaining tip work and osteotomies are then completed.

Tip Reconstruction Using the Tripod Concept

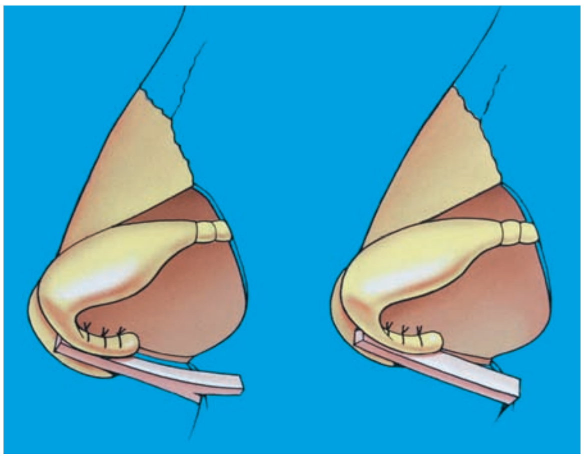
Once the nasal dorsum has been treated, attention is redirected to the tip. Estimated tip projection is confirmed, final tip projection is established, and tip cartilages are reconstructed. The tripod concept, which relates nasal tip support and shape to the paired lower lateral cartilage complexes, is a useful premise for nasal tip reconstruction and correction of deformed lower lateral cartilages.



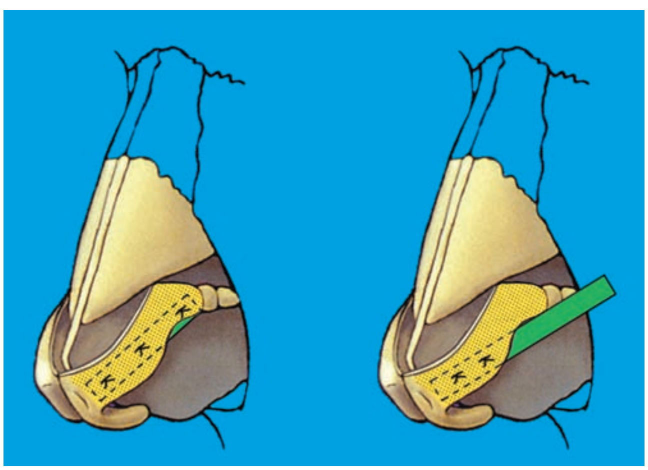
Each lower lateral cartilage complex consists of a medial crus (including the intermediate crus) and a lateral crus. These paired complexes can be visualized as a tripod, with each lateral crus forming a separate cephalic lateral leg and the adjoining medial crura forming the caudal, third leg.[15] This concept is helpful to anatomically simulate paired lower lateral cartilage complexes, and reestablishment of this tripod is the goal of all nasal tip reconstruction.

To be successful, the reconstructed tripod structure must have the strength to support the tip and prevent the alar sidewalls from collapsing and the shape to provide the nasal tip with an aesthetically pleasing, natural appearance. Septal, auricular, and rib cartilage can be employed. Each has inherent advantages and disadvantages.

Support for the central leg of the tripod should be reconstructed first. In some cases tip support and projection can be achieved with septal extension grafts or extended spreader grafts. These grafts are suture fixated to the septum in the area of the septal angle, and they extend into the tip-lobule complex. A stable caudal septum is required.



Tip support and projection can be effectively reestablished with a columellar strut. Septal cartilage is appropriate for most columellar struts. However, a rib cartilage columellar strut allows maximum tip support.



The method used for rebuilding the lateral legs of the tripod (lateral crura) depends on several factors. The most important factors are (1) the amount of usable cartilage present in the tip and (2) the type of cartilage (septal, auricular, or rib) available for grafting. For tip deformities in which the lower lateral cartilages are present but collapsed or mildly deformed, lateral crural strut grafts fashioned

from septal or auricular cartilage are the treatment of choice to reestablish shape and stability of the lateral legs of the tripod.[16] These grafts are placed in an undermined pocket between the undersurface of the lateral crus and the vestibular skin and are sutured to the crus for stabilization. They are used to correct alar retraction, alar rim collapse, and concave, convex, or malpositioned lateral crura. Lateral crural strut grafts are extended laterally to overlap the piriform aperture and end in an undermined pocket inferior to the alar groove. If the pocket is created superior to the alar groove, a visible bulge may be present above the ala. We use a columellar strut in almost all cases of nasal tip reconstruction to stabilize the caudal leg and thereby resist displacement by scar tissue contraction or swelling.

When the lateral crura are absent or so deformed that they cannot be used, correction is more challenging, and autologous rib cartilage has proved to be the cartilage of choice. If the lateral crura are not usable but the medial crura and domes are intact, a columellar strut is sutured between the medial crura to strengthen the caudal leg of the tripod. Next, vestibular skin is undermined off the undersurfaces of the domes. The lateral crural strut grafts are sutured to the undersurface of each dome to replace the missing lateral crura.

If both the medial and lateral crura are absent or unusable, autologous rib cartilage is used. It is carved as a shaped columellar strut to act as the caudal leg of the tripod to simulate the contour of the caudal margins of the medial crura and medial portion of the domes along the columella-infratip lobule.

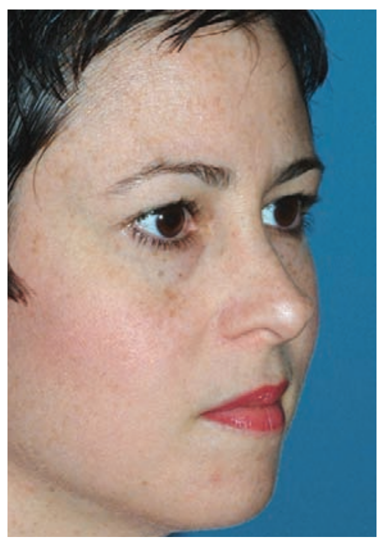
The lateral legs of the tripod are reconstructed in a fashion similar to that used when the domes are present. The only difference is that instead of the medial ends of the lateral crural strut grafts being sutured to the undersurface of the domes, the grafts are sutured to the tip of the shaped columellar strut to replace the missing lateral crura. It is preferable and easier to suture the lateral crural strut grafts to the undersurface of the domes, when they are present, than to the tip of the columellar strut. If the domes are absent, the shaped strut and lateral crural strut grafts are tapered. A soft tissue onlay graft of fascia or perichondrium is an effective means of camouflaging irregularities of the tip cartilages and graft edges.

Wound Closure and Splints

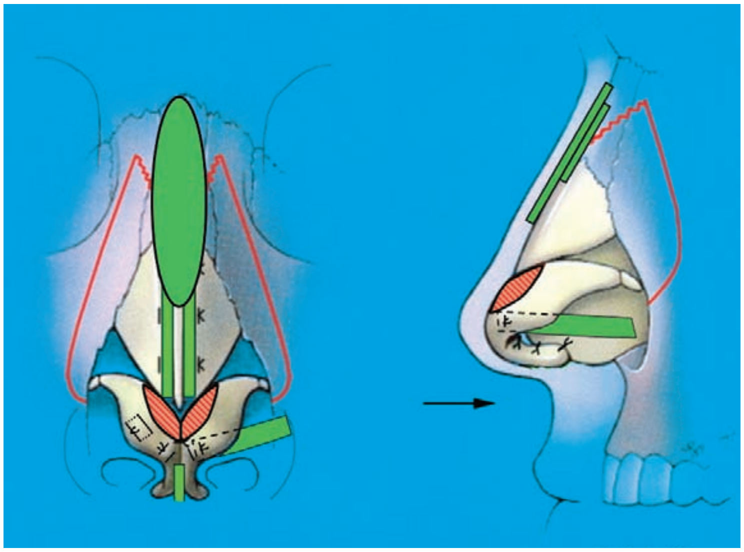
The nasal framework undergoes a final inspection, and skin is redraped. The external appearance and nasal interior are evaluated, and incisions are closed. The infracartilaginous incisions are closed with interrupted 5-0 chromic sutures. The transcolumellar incision is meticulously closed with interrupted 6-0 nylon sutures. No subcutaneous sutures are necessary. If septal work has been performed, bilateral septal splints are placed and sutured in place with through-and-through 3-0 nylon sutures. Nasal packing is not used if hemostasis is adequate. Steri-Strips and an aluminum cast are placed on the nose and remain in place for 1 week.

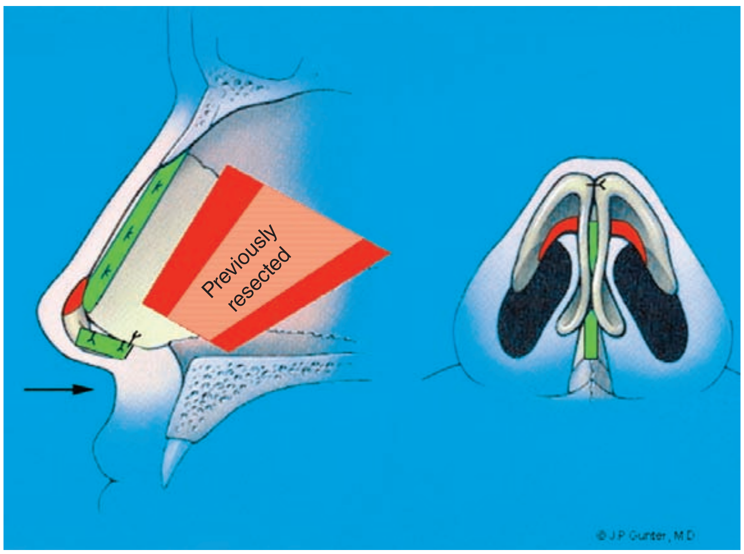
CASE ANALYSES

Secondary Rhinoplasty With Septal Cartilage and Auricular Cartilage Grafts



This 39-year-old woman had two previous rhinoplasties by another surgeon. She had difficulty breathing and a deviated septum. On the frontal view, an inverted-V deformity of her dorsum was evident, with upper lateral cartilage collapse and a wide bony dorsum. Her tip was asymmetrical and bulbous. Her profile view showed a low radix position. Her tip projection was exaggerated in relation to the dorsal height.



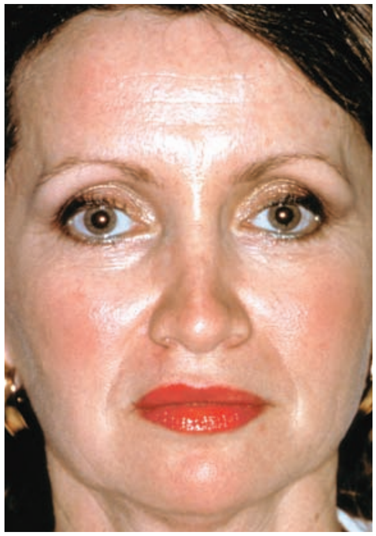


Surgical Plan

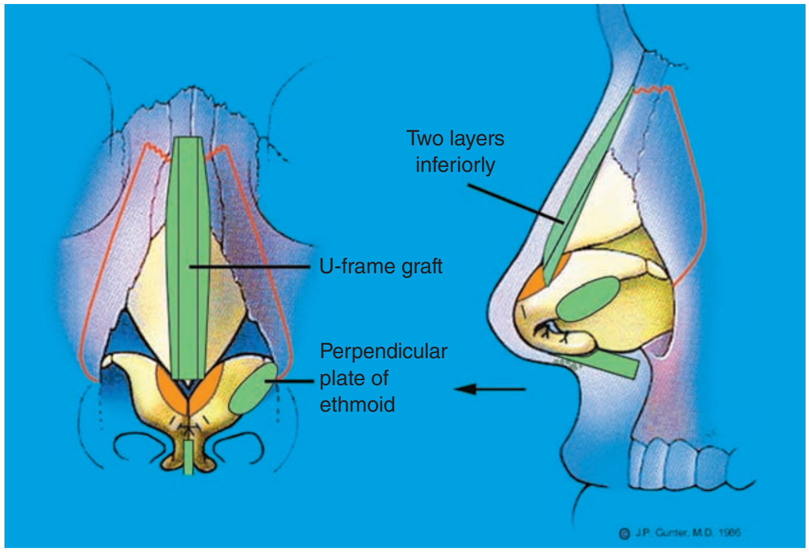
1. Use an open approach.
2. Perform a septoplasty with septal cartilage harvest.
3. Harvest auricular cartilage for use as graft material.
4. Augment the dorsum with a two-layer septal cartilage onlay graft.
5. Place a bilateral spreader graft.
6. Place a columellar strut graft.
7. Place a unilateral lateral crural strut graft.
8. Place a unilateral horizontal mattress suture on the lateral crus.
9. Place transdomal sutures.
10. Perform lateral osteotomies.

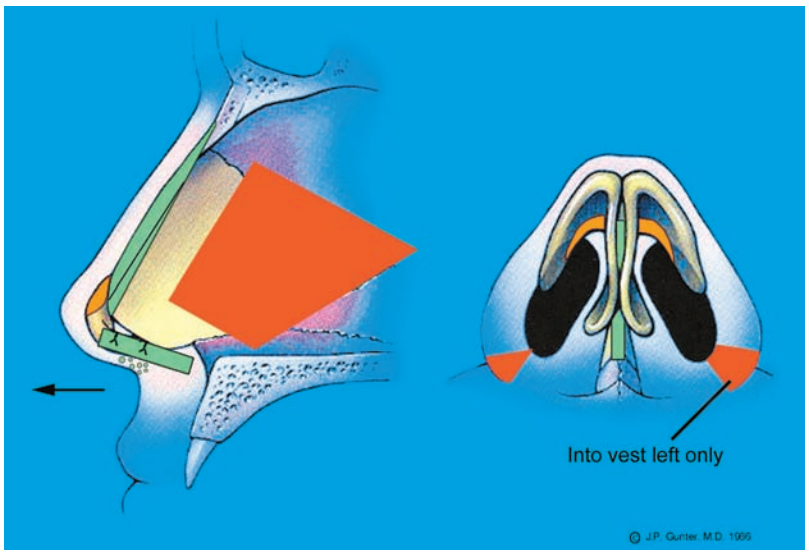
The patient is shown 1 year postoperatively. On the frontal view, her inverted-V deformity is corrected, and dorsal aesthetic lines are restored. Tip asymmetries are corrected by the columellar strut graft and lateral crural strut graft on the right. On the lateral view, her radix is repositioned cephalad with the use of a dorsal onlay graft, and the tip is slightly deprojected to correct her dorsum-tip proportions.

Augmenting the Nasal Dorsum and Increasing Tip Projection With Septal Cartilage Grafts



This 42-year-old woman had rhinoplasty 20 years previously. She had difficulty with nasal breathing, especially through her left nostril, and thought that her nose was widening. On the frontal view, the middle third of her nose was narrowed as a result of collapsed upper lateral cartilages, her supratip area was asymmetrical, and her alar base was wide. The lateral view demonstrated a low nasal dorsum with decreased tip projection, fullness in the supratip area, and a very acute columellar-labial angle. The basal view showed decreased tip projection and nostril asymmetry. The internal examination revealed deviation of the septum and bilateral collapse of the internal nasal valve areas.



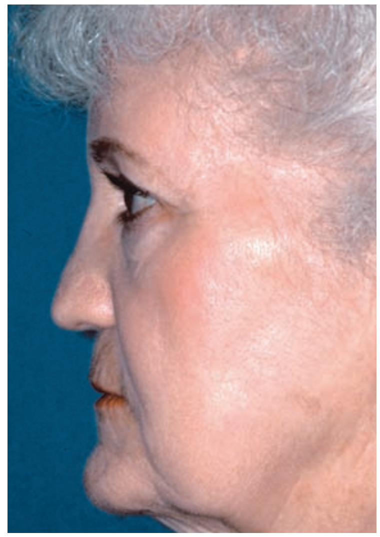


Surgical Plan

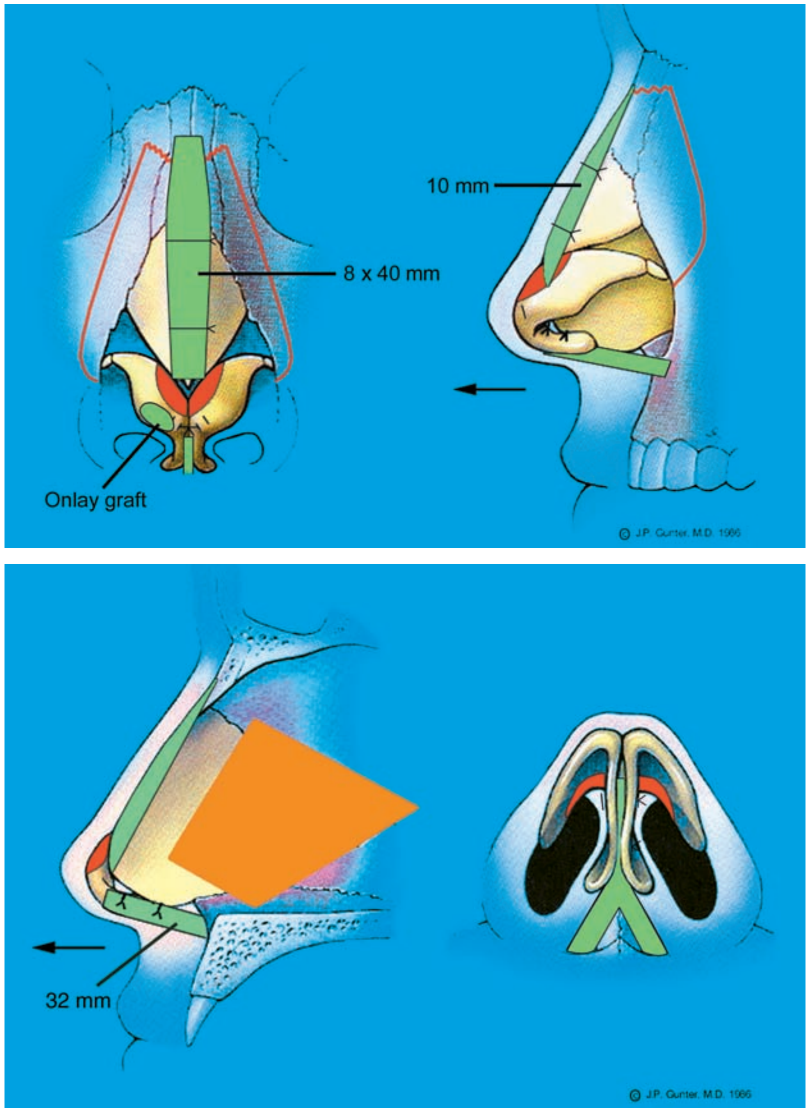
1. Use an open approach.
2. Perform a septoplasty.
3. Augment the dorsum with a U-frame graft.
4. Place a columellar strut graft.
5. Perform cephalic trim of the lower lateral cartilages.
6. Place transdomal sutures.
7. Harvest a piece of the perpendicular plate of the ethmoid for placement in the left alar groove.
8. Reduce the alar base.

The patient is shown 1 year postoperatively. Her dorsal deformity is corrected with an inverted U-frame dorsal onlay graft. Tip asymmetry is improved after cartilage trimming, suture repositioning and reshaping, and placement of an onlay graft of the perpendicular plate of the ethmoid in the left alar groove area. Tip projection is increased with a columellar strut graft. This graft, along with morselized cartilage grafts, helped to open her acute columellar-labial angle. Nostril asymmetry is improved by asymmetrical alar base resections.

Correction of Significant Loss of Tip Projection and Dorsal Height With Autologous Rib Cartilage Grafts



This 61-year-old woman had an accident as a child and underwent surgery at age 18 to correct a nasal deformity. As she aged, nasal breathing became more difficult and caused considerable problems. On the frontal view, both the bony base and alar base were wide. The nasal dorsum was flat, and she had no columellar show. The lateral view showed decreased tip projection, insufficient dorsal height, and a retracted columellar-labial angle, resulting in decreased columellar show. A wide alar base, lack of tip support, and nostril asymmetry were evident on the basal view. The internal examination revealed a slightly deviated nasal septum with a small central perforation. Her nasal valves were collapsed, and she had no caudal septal support.



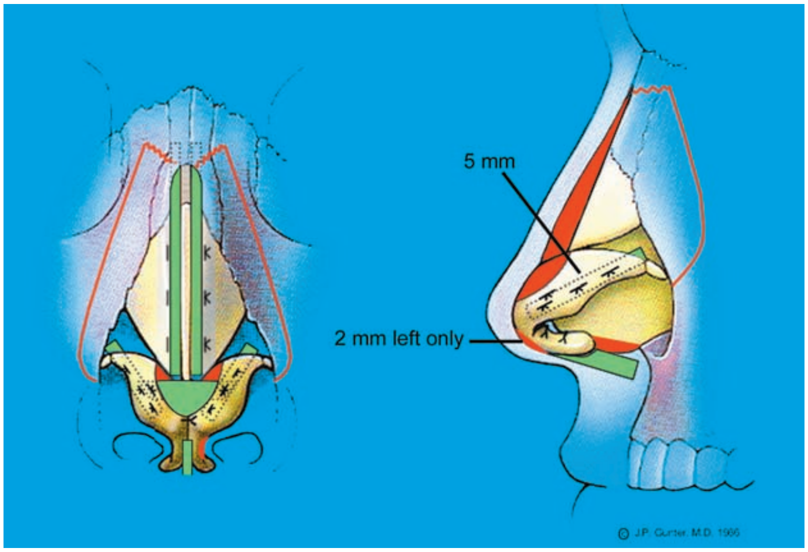
Surgical Plan

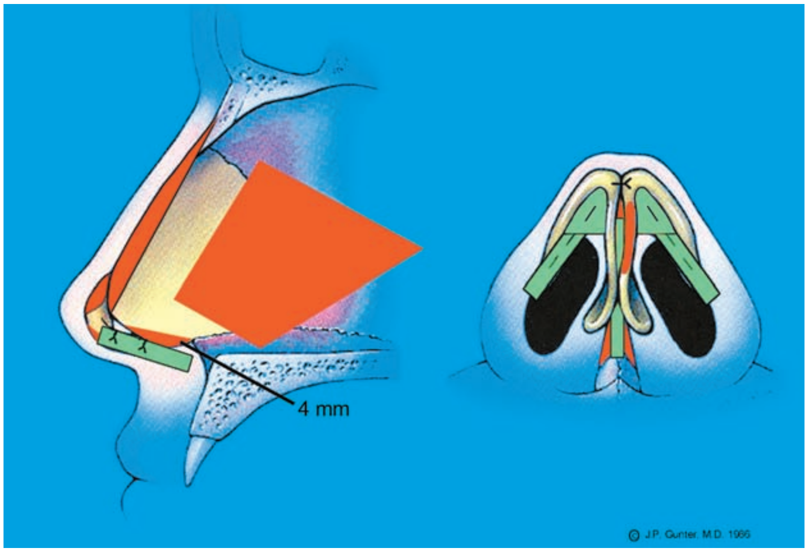
1 Use an open approach.
2. Perform a septoplasty.
3. Augment the dorsum with a rib cartilage dorsal onlay graft.
4. Place a columellar strut graft composed of rib cartilage that is notched at the base and fixed at the nasal spine.
5. Place transdomal sutures.
6. Harvest a piece of the perpendicular plate of the ethmoid graft for placement in the left alar groove.
7. Perform lateral osteotomies.

Fourteen months postoperatively her intercanthal distance appears to be reduced and her dorsum is narrower because of the dorsal onlay graft and lateral osteotomies. Tip projection is increased after advancement of the medial crura on the columellar strut, which has resulted in decreased alar base width, an oval appearance of the nostrils, increased columellar show, and a more obtuse columellar-labial angle. Trimming of the lateral crura and reshaping of the dome areas with sutures along with the onlay graft have created a more sculpted, symmetrical tip.

Correction of Severe Nasal Tip Deformity With Autologous Septal Cartilage

This 31-year-old woman's nose was broken when she was 13 years of age. She had two prior nasal surgeries in an attempt to correct the problem. The last surgery was performed 8 years previously. The patient continued to have breathing problems and did not like the appearance of her nose, especially the nostrils. On the frontal view, the dorsum appeared tubed and deviated to the right, with a narrowing of the middle third. Increased infratip lobular show resulted from severely retracted alae and a hanging columella. The lateral view showed a shallow nasofrontal angle, with a slightly high bridge and inadequate infratip lobular projection. The marked increase in columellar show was caused by the combination of a hanging columella and retracted alae. The basal view revealed asymmetry of the nostrils with a slightly widened distance between the tip-defining points. The left dome appeared more projected than the right.





Surgical Plan

1. Use an open approach.
2. Rasp the dorsum.
3. Resect 4 mm of the caudal septum.
4. Perform a septoplasty.
5. Place dorsal spreader grafts.
6. Place a columellar strut graft.
7. Place lateral crural strut grafts.
8. Place an alar spreader graft.
9. Perform lateral osteotomies.

The patient is shown 17 months postoperatively. Osteotomies and spreader grafts have straightened the nose and corrected the collapsed upper lateral cartilages. Infratip lobular show is decreased after raising of the columella, trimming of the medial crura, and lowering of the alar rims with double-layer cartilage grafts wedged and sutured between the undersurface of the lateral crura and upper lateral cartilages. These grafts also widened the alar rims, creating a more aesthetic appearance. The profile view shows a straighter dorsum with a slight supratip break and an improved alar-columellar relationship. Differential advancement of the medial crura on the columellar strut graft equalized the height of the domes, as seen on the basal view.

CONCLUSION

The major advantage of an open approach in the management of secondary nasal deformities lies in the complete, undistorted anatomic exposure of the nasal framework. This allows a precise anatomic diagnosis and correction of the deformity with original tissues and supplemental cartilage grafts. Bony and cartilaginous structures can be continuously assessed intraoperatively. Final anatomic alignment and symmetry of the nasal framework become more predictable. Despite the advantages of an open approach, it is not indicated for every secondary nasal deformity. Minor asymmetries or underresection can sometimes be corrected endonasally, but for major deformities the open approach is preferred.

The major potential disadvantage of an open rhinoplasty technique is a transcolumellar scar. However, the use of a broken-line incision across the columella with strict attention to operative technique during closure, the scar is usually indistinguishable at conversational distances. Wound separation and delayed secondary healing are rare occurrences. An open approach increases operating time and can prolong tip edema. Increased operating time is necessary for the suture stabilization required for grafting and repositioning of the anatomic structures and accurate closure of the transcolumellar incision.

Because autologous rib cartilage provides the most abundant source of cartilage for graft fabrication and is the most reliable source when structural support or augmentation is needed, it has been our graft material of choice for secondary rhinoplasty when sufficient septal cartilage is not available.

Major postoperative nasal deformities having a distorted nasal framework with aesthetic and functional compromise are a difficult problem. The complexity of secondary nasal deformities requires strict adherence to the basic principles as described, an understanding of the individual's aesthetic nasal analysis, and a systematic treatment plan. The use of an open approach for major postoperative nasal deformities has produced more consistent aesthetic and functional results in the management of these multifaceted problems.

KEY POINTS

- Success in secondary rhinoplasty relies on an accurate clinical diagnosis and analysis of the nasal deformities, a thorough operative plan for each abnormality, and meticulous surgical technique.
- Reconstruction of the osteocartilaginous framework is the foundation for consistent aesthetic and functional results in secondary rhinoplasty.
- We prefer to treat most secondary rhinoplasty deformities using the open approach in an effort to ensure consistent aesthetic and functional results.

- A thorough nasal analysis and precise anatomic diagnosis of each deformity are key steps to achieving optimal results in secondary rhinoplasty.
- Operative goals are individualized for each patient according to the deformity.
- Autologous rib cartilage has been our graft material of choice for secondary rhinoplasty when sufficient septal cartilage is not available.
- A crucial step in the operative sequence is the assessment of adequate tip projection, because reduction or augmentation of the dorsum should be performed with the final tip projection in mind.
- Soft tissue irregularities and scar tissue should be judiciously removed from the undersurface of the soft tissue envelope to prevent overlying irregularities.

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Closed Approach in Secondary Rhinoplasty

Mark B. Constantian

Successful primary rhinoplasty is the key to successful secondary rhinoplasty. Fundamental to both are familiarity with nasal phenomenology, soft tissue response to various skeletal alterations, and the effect of reducing support on the nasal airway. In practice, therefore, diagnosis is not necessarily more difficult in secondary patients than in primary ones if the surgeon understands normal anatomy and what happens as a result of the usual reduction maneuvers or the newer grafting or cartilage suturing techniques.

In secondary patients, however, the approach is the reverse of primary rhinoplasty: instead of identifying anatomic traps and modifying the surgical plan accordingly, the surgeon observes the sequelae of failing to recognize those anatomic traps and must correct the consequences.

Successful primary rhinoplasty is the key to successful secondary rhinoplasty.

The only deformities or anatomic variations that are important are those that distort the surface or obstruct the airway.

Primary and secondary rhinoplasty are thus two sides of the same coin, which creates a unity between the operations. If the surgeon removes or repositions deforming structures, maximizes function and equilibrium between soft issue and skeletal suppport, uses incisions and dissection economically, and augments to create balance, contour, and structure, there is really no difference between primary and secondary rhinoplasty except the donor sites.

There is no difference between primary and secondary rhinoplasty except the donor sites.

The closed approach holds several advantages over the open approach in secondary rhinoplasty. Dissection can be restricted more easily, treatment of patients with limited donor materials is more simply accomplished, and expansion of a tight, scarred tip does not place tension on the columellar closure.

Surgeons who use the closed approach on some patients and the open approach on others usually reserve the open approach for the most complicated, distorted, anatomically difficult cases. I think that strategy is exactly backward. The more difficult the case, the more limited the donor material, and the more new support is required, the more valuable it is to be able to make intraoperative judgments from a skin surface that is undisturbed and maximally vascularized. Surgeons who perform both open and closed rhinoplasty may therefore wish to rethink their strategy and consider open access for well-vascularized, supple, primary cases and the closed approach for scarred and distorted secondary and tertiary patients. Columellar or nasal tip necrosis after secondary open rhinoplasty is almost never reported and rarely discussed, but it does occur, even in expert hands. On the other hand, soft tissue loss following closed rhinoplasty can almost always be avoided by careful technique.

The more difficult the case, the more limited the donor material, the more scarred the soft tissue cover, and the more valuable it is to limit dissection, the greater the advantage of the closed approach.

The case that I make for anatomic diagnosis in primary rhinoplasty applies just as well to secondary rhinoplasty (see Chapter 17). The only deformities or anatomic variations that are important are those that distort the surface or obstruct the airway. Anatomic variations that are exposed only by opening the nose, but that neither deform the surface nor obstruct the airway, may be intellectual niceties, but finding them is not relevant to treating the patient. The surgical objectives are based instead on internal septal and valvular examination and on inspection and palpation of the surface. The surgical plan is based on the same three criteria used in primary rhinoplasty: (1) skin thickness and distribution, (2) tip lobular shape, and (3) the balance between nasal base size and the length of the dorsal line. Since the actual techniques are substantially the same, discussion of secondary rhinoplasty is really a discussion of donor sites, diagnosis, and strategy.

UNIQUE CONSIDERATIONS IN SECONDARY RHINOPLASTY

Although primary and secondary rhinoplasty share common anatomy and phenomenology, distinct differences separate the two: deformity patterns, tissue tolerance, donor site depletion, and patient depletion.

Deformity Patterns

Secondary rhinoplasty deformities are not limitless; they form one of three patterns:

1. Deformities from soft tissue contraction (as seen in the patients on pp. 812-815 and 832)
2. Deformities from skeletal contraction (as seen in the patients on pp. 814-815, 817, and 819)
3. Deformities from imbalance (as seen in the patients on pp. 810 and 834)

Secondary rhinoplasty deformities are not limitless; they form one of three patterns: deformities from soft tissue contraction, deformities from skeletal contraction, and deformities from imbalance. Thus the solutions follow patterns.

The good news for the surgeon is that because deformities follow patterns, their solutions can also follow patterns. This principle applies equally to primary rhinoplasty and is discussed in Chapter 67.

Tissue Tolerance

The tissues of secondary rhinoplasty patients have undergone irreversible changes; they will not tolerate extensive dissection, thinning procedures, and multiple incisions, and sometimes not even the columellar and tip exposure required for the open approach. Every prior operation alters soft tissue and skeletal characteristics. The skin becomes less pliable, less able to expand, and less tolerant of underlying pressure. Every previously placed suture or graft has introduced a variable. Unyielding soft tissues resist expansion and compress the grafts placed beneath them. A scarred, hypovascular bed increases the incidence of graft absorption, which is uncommon in primary rhinoplasty.

Donor Site Depletion

The population of secondary patients is changing. Thirty years ago, many surgeons would not attempt secondary rhinoplasty, so most patients had undergone just a single closed operation and had intact septa. All that has changed, and

today most secondary rhinoplasty patients have undergone two or more procedures by their original surgeon or by other surgeons; grafts and sutures have been tried, and donor sites have been exhausted and deformed. Surgeons who expect to perform secondary rhinoplasty must therefore become facile with septal, ear, and rib cartilage as well as rib and calvarial bone grafts. Each has its optimal uses.

Patient Depletion

Paralleling changes in soft tissue and donor sites, the patients themselves are depleted. Having undergone one or more unsuccessful procedures, secondary rhinoplasty patients usually have higher levels of preoperative apprehension and a lower tolerance for postoperative problems or disappointments. The surgeon electing to treat such patients must learn the specifics of the operation and perform a biologically sound surgical plan.

Since they have already invested money, time, discomfort, and emotion in one or more unsuccessful procedures, what secondary patients fear most and need least are additional disappointments.

Often unspoken, but quite common, is a profound sense of guilt felt by the patient—guilt that he or she did not provide enough information to the first surgeon, did not ask enough questions, did not do enough research into the surgeon's qualifications, or did not validate the correctness of the proposed procedure. This guilt, which seems deeper among rhinoplasty patients than with other revision patients, increases patient anxiety and should be anticipated and recognized.

Four distinct differences separate primary and secondary rhinoplasty: deformity patterns, tissue tolerance, donor site depletion, and patient depletion.

PREOPERATIVE ASSESSMENT AND PLANNING

The Interview

Secondary rhinoplasty patients are considered to be a demanding and difficult group; however, in their defense, there are virtually no other plastic surgical operations in which the patient can lose ground every time. Patients who started with normal airways and modest aesthetic problems before their rhinoplasties but have become mouth breathers with deformed noses could justifiably be more difficult than many of them are. Given their histories of disappointments, it is even more important that the surgeon treating secondary rhinoplasty patients

construct a safe and biologically sound surgical plan that he or she can execute, and also that patient and surgeon have an accurate understanding of the aesthetic goals and the realities of the surgical problem—that is, what is possible and what is not.

Although significant improvement is often possible, the patient must be guided to understand that every rhinoplasty is a compromise between the patient's aesthetic goals and the limitations that the operated skeleton and soft tissue configuration impose. Each patient's donor material varies in quantity and character, which determines its usefulness in a specific situation.

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Patient History

When interviewing secondary patients (and aside from routine questions about trauma, allergies, suppurative sinusitis, snoring, epistaxis, or rhinitis), the surgeon must find out what the patient was originally trying to accomplish before the first operation (or operations). Some patients are so discouraged that they almost do not care how the nose will look, as long as the airway can be restored, but my objective is always to achieve the original goal, if at all possible, assuming that it was reasonable. I then try to determine what the prior surgeon has done and what has happened thereafter. Patients can often supply photographs of their preoperative appearances, which are tremendously instructive in determining not only how the nose has changed but in understanding the nasal phenomenology as well. Prior operative reports are sometimes helpful, but I rely much more heavily on my own examination.

The surgeon should always examine the internal nose first to avoid being distracted in the discussion of aesthetics. Many patients are fully aware of their airway obstructions; some have lost their airways slowly (as edema from the first surgery resolved) and may not be aware of the obstruction.[1-3] I palpate the nasal septum to see how much graft material is left and, if a septoplasty has been performed previously, how wide the dorsal and caudal struts are. I examine the nose during quiet and forced inspiration to check for valvular competence, and I look for normal anatomy that has now become distorted (for example, malpositioned lateral crura buckled into the airway). I examine the turbinates, but I do not place heavy emphasis on them, because most airways can be completely cleared without turbinectomy, and our prior reports[1-4] have shown that 97% of consecutive

primary and secondary patients will report normal nasal airflow after rhinoplasty in the absence of turbinectomy.

The internal nose should always be examined first to avoid being distracted in the discussion of aesthetics.

Palpating the external nose provides information about the length of the bony vault, the middle vault support, and the size and substance of any remaining alar cartilages.

Establishing Surgical Goals With the Patient

Because virtually all secondary rhinoplasty requires augmentation for support or contour, the major preoperative discussion in my practice concerns the selection of donor sites and an explanation of where grafts should be placed, and why. Most patients understand that they have areas that have collapsed or have been excessively reduced and are still not the right shape. A few patients, however, are so wedded to a reduction rhinoplasty that the augmentation rationale is difficult to accept. Each patient must not only agree to the plan but prefer it to the reasonable alternatives.

Every patient must also understand that even a carefully done secondary rhinoplasty may still be imperfect and require further revision. In fact, revisions or additional stages may be predictable in difficult configurations if the patient desires the best possible result.

It is critical that patient and surgeon trust and understand each other. A patient who is still angry at the previous surgeon and cannot be convinced that the surgeon did his or her best to solve the patient's problem is not a good surgical candidate unless that misconception can be completely corrected. Many surgeons still believe that plastic surgeons have special gifts that will allow them to defy the usual laws of biology, and the puffery of Internet marketing has only worsened that misconception. The patient must not only understand the surgical plan and approve it but must also recognize what is controllable and what is not.

A patient who is still angry at the previous surgeon and cannot be convinced that the surgeon did his or her best to solve the patient's problem is not a good surgical candidate unless that misconception can be completely corrected.

Preoperative Examination and Formulating a Surgical Plan

In practice, diagnosis is not any more difficult in secondary patients than in primary ones if the surgeon understands normal anatomy and what happens as a result of the usual reduction maneuvers or the newer techniques of grafting or tip cartilage suturing. With occasional exceptions, the deformities in secondary patients are not limitless but most often correspond to the four anatomic variants discussed in Chapter 67: low radix or low dorsum, inadequate tip projection, narrow middle vault, and alar cartilage malposition. In secondary patients, one sees the other side of the coin—that is, instead of seeing the traps and knowing how to anticipate them, the surgeon observes the sequelae of failing to recognize them and now must correct the result. Not only are these four anatomic variants common but they produce the most significant deformities that compel secondary patients to seek further surgery.[4,5]

Low Radix or Low Dorsum

Failure to recognize a low radix or low dorsum contributes to collapse of the middle vault and also creates postoperative imbalance so that the lower nose looks even larger to the patient than it did preoperatively.

Unrecognized low dorsum
in unoperated nose

This patient had a low dorsum that was unrecognized before his primary rhinoplasty.[5] Patients cannot understand how the surgeon actually made the bottom of the nose larger, when in fact he or she did not; the surgeon simply made the upper nose smaller and increased the aesthetic discrepancy.

Failure to recognize a low radix or low dorsum contributes to collapse of the middle vault and also creates postoperative imbalance—a nose that appears bottom heavy. The patient often complains that the lower nose has become larger since the primary operation. The treatment is grafting to the radix or dorsum.

The same patient as on p. 809 is shown before and 2 years after secondary rhinoplasty. The preoperative images demonstrate the protean effects of dorsal reduction during his primary rhinoplasty: an increase in apparent nasal base size,

nasal shortening, and middle vault collapse. In the secondary surgery, calvarial bone dorsal and septal cartilage tip grafts were placed. Similar to spreader grafts, substantial dorsal grafts laterally distract the middle vault and therefore improve internal valvular competence. Because the intact cartilaginous roof provides middle vault support, a significant dorsal resection will also create internal valvular incompetence. Finally, unless the soft tissues of the upper nose can contract sufficiently, a low dorsum contributes to the production of a supratip deformity.

In the patient's original unoperated nose, the low radix or low dorsum should have been corrected by augmentation. That was still the correction for the secondary procedure, except that more augmentation was needed. If dorsal augmentation is significant enough (2 to 3 mm or more), spreader grafts are not necessary; however, if the dorsum only needs to be leveled by a thin graft, the middle vault should be treated separately for its associated collapse.

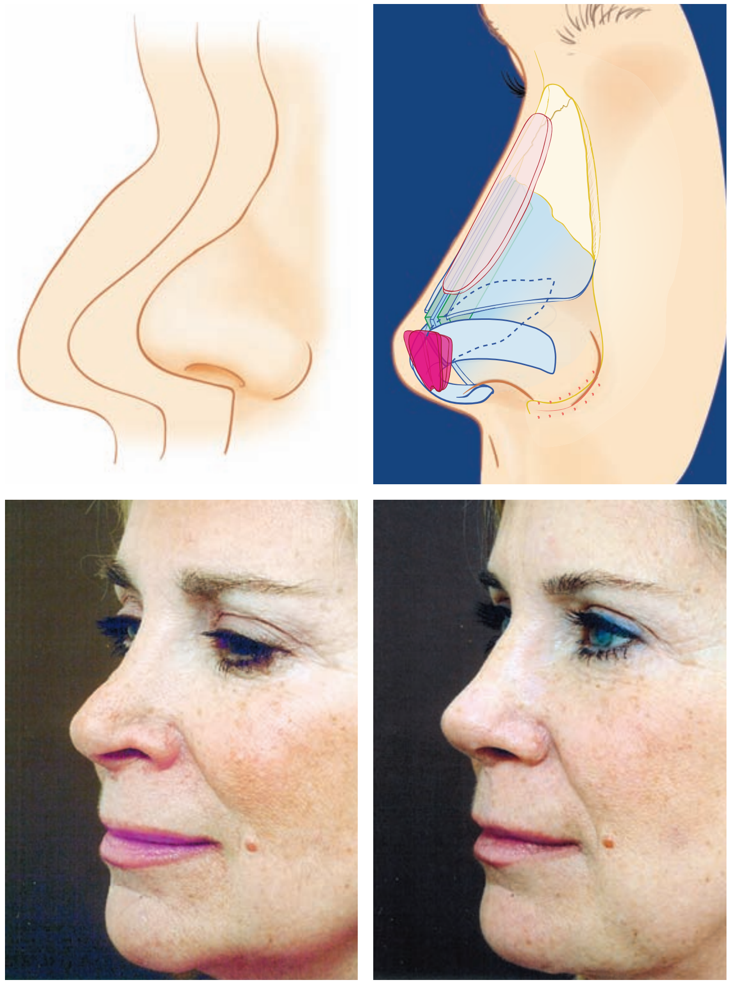
Inadequate Tip Projection

Tip projection reflects lower lateral cartilage middle crura strength, not skin volume. This is a critical distinction.

Inadequate tip projection, meaning the lower lateral cartilages are not strong enough to support the nasal tip independent of the height of the dorsum, cannot be rendered adequate by reduction methods alone. Tip projection indicates cartilage strength (specifically, the length and substance of the lower lateral cartilage middle crus), not skin volume. Many surgeons do not know how to recognize inadequate tip projection, or they use a method that is inaccurate, and others recognize it but cannot correct it. Since the anatomic deficiency in inadequate projection is a short middle crus, tip grafting is the most logical solution for inadequate tip projection. Tip grafts correct a structural deficit, whereas sutures can only borrow from another area of the lower lateral cartilage; a deficit remains somewhere.

Failure to recognize inadequate tip projection in a primary nose usually creates supratip deformity. The patient will complain that the dorsum is still not straight or that the tip is "bigger" or has lost shape.

Many surgeons do not know how to recognize inadequate tip projection, or they use a method that is inaccurate, and others recognize it but cannot correct it.



The drawing on the left shows soft tissue contraction after reduction disequilibrium, ending in supratip deformity.[6] This tertiary rhinoplasty patient had flat, malpositioned lateral crura. Because her external valves were incompetent, the patient flared her nostrils to support her airways. The image on the left is a preoperative view, and the image on the right shows the patient 18 months after resection and replacement of the lateral crura and dorsal, spreader, and tip grafts. Note the change in alar rim contour conferred by normalizing alar wall support. Postoperative nasal airflow increased 22 times over preoperative values.

When the lower lateral cartilages are insufficient to support the tip or have been reduced beyond the ability of the nasal tip tissues to contract, the tip lobule contracts concentrically and posteriorly, flattening in its middle third, and bulging superiorly, inferiorly, and laterally to produce the round, globular appearance of supratip deformity.

By definition, inadequately projecting tips have middle crura that are too short to provide tip support, so the most anatomic treatment is augmentation of the tip lobule with autologous grafts. If the patient has a supratip deformity and the middle crural remnants cannot be recognized from the surface, I ignore them

and place tip grafts anterior to them. In patients in whom an angle of rotation in the tip does not exist,[7] a rigid graft of uncrushed cartilage or ethmoid should be placed first and other grafts placed anterior to it to create a normal lobular contour (see Chapter 67).

If the lower lateral cartilage middle crura are not long enough to project the tip to the dorsal line, the lobular soft tissues contract concentrically and posteriorly. This skeletal deficit is most effectively corrected by augmenting with tip grafts.

This secondary rhinoplasty patient brought with her a photograph of her unoperated nose. Her original aesthetic goal had been to reduce the size of a nasal tip that she perceived as bulbous. Three rhinoplasties and insertion of a dorsal silicone prosthesis left her graft depleted, because 90% of the nasal septum and cartilage from one concha had been removed. Airway obstruction existed from internal valvular incompetence and loss of support to the external valves fol-

lowing lower lateral cartilage reduction. Now the patient's aesthetic and surgical goals were to remove the cold-sensitive movable prosthesis that threatened to extrude, correct airway obstruction, and restore the preoperative retroussé and convex lateral crural configuration.

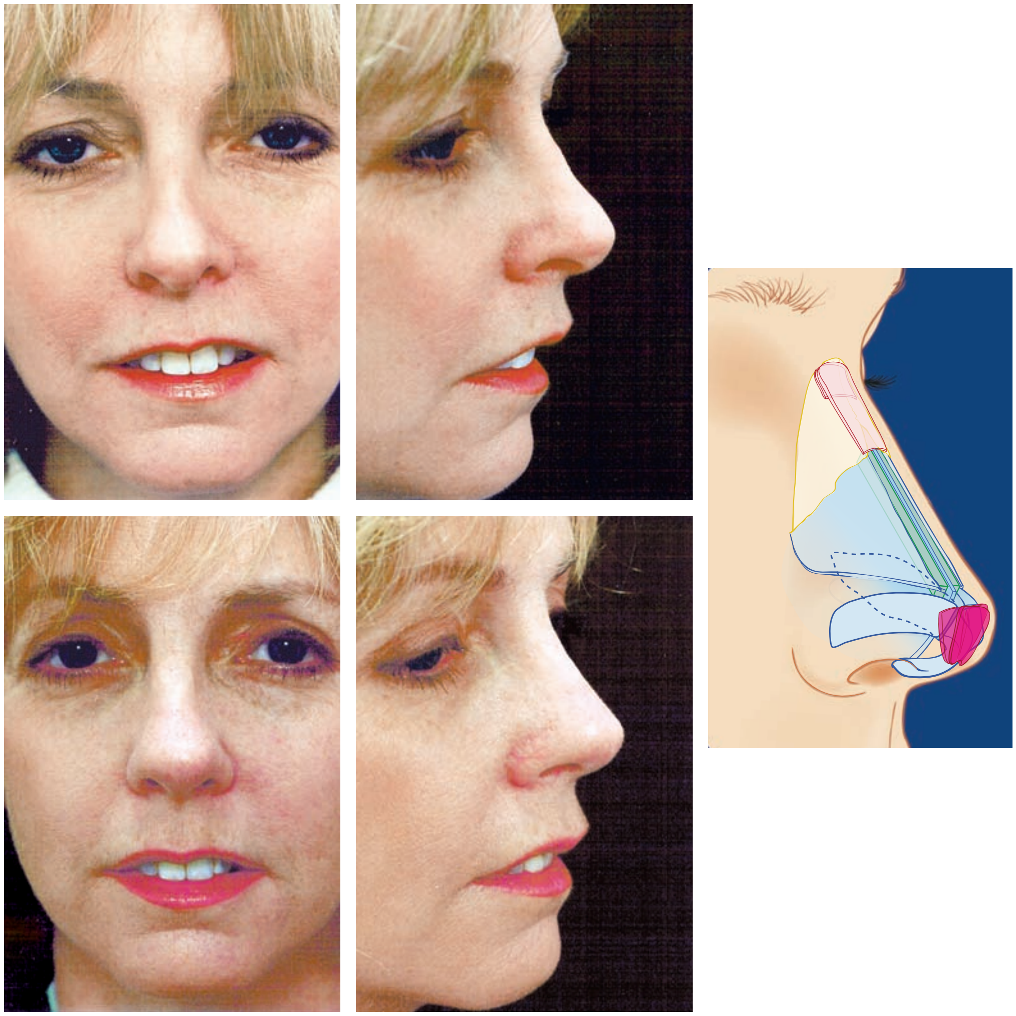
The surgical plan consisted of maxillary augmentation, removal of the silicone implant, and placement of a dorsal graft of calvarial bone and composite skin/ conchal cartilage grafts, in which the cartilaginous segment replaced the convex lateral crura and supported the external valves and the skin island replaced the vestibular skin deficiency. Multiple ear cartilage tip grafts were necessary.

Postoperative views show an improved contour of the maxillary arch, support of the lateral alar walls, and restoration of the patient's convex preoperative tip lobular configuration. The calvarial graft has solidly united to the bony arch.

Narrow Middle Vault

The narrow middle vault is easy to identify on internal examination but it is sometimes not visible externally as the characteristic inverted-V deformity if the soft tissues are thick enough to obscure it. The patient should be able to feel the difference between the width of the upper and middle thirds, understand that the lateral wall may be lying flat against the septal partition, and recognize that airflow is significantly improved when the internal valves are supported with a Q-tip during inspiration. Treatment is by spreader grafts or a substantial dorsal graft.

This patient had a low radix, narrow middle vault, and a tip lobule that projected only to the septal angle.[5] She is shown before her primary rhinoplasty.



Dorsal and tip reduction during primary rhinoplasty collapsed the middle vault and produced supratip deformity. Although the dorsal convexity is lower, note the similarity to the patient shown on p. 822. She is shown 18 months after dorsal, spreader, alar wall, and tip grafts were placed. Mean nasal airflow has increased 28 times as a result of re-creation of valvular competence. Frontal and oblique views confirm the confluence of the upper, middle, and lower nasal thirds.

A narrow middle vault indicates internal valves that are often incompetent; dorsal resection will further narrow the middle third and worsen the airway. The narrow middle vault is easy to identify on internal examination, but it is sometimes not visible externally as the characteristic inverted-V deformity if the soft tissues are thick enough to obscure it. The treatment is dorsal or spreader grafts.

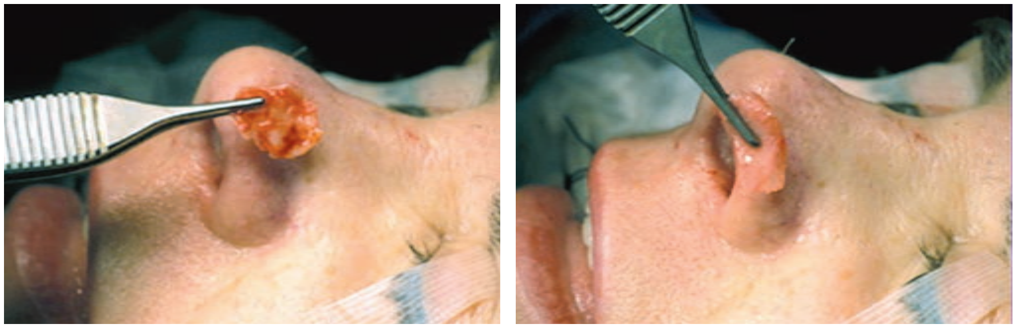
Lateral Crural Cartilage Malposition

Despite the fact that malposition occurs in approximately 50% of the population according to my prior series,[4,8,9] and the deformity was described nearly 30 years ago and has been discussed in the literature since then,[1,2,4,8,9] I have only once seen a patient in whom the primary surgeon identified malposition and made an attempt to correct it. The appearance of patients with prior malposition is characteristic because resection of the lateral crus always creates deformities that lie along a single spectrum: at one end is the thick-skinned patient with a deep alar crease that may run to the rim and an alar rim that is flat rather than convex; at the other end is the thin-skinned patient whose alar cartilages have knuckled at the domes and produced a sharply concave alar rim with alar creases that run to them and nostril margins that are retracted cephalad. Often these patients unconsciously flare their nostrils to support the airways during inspiration.

Malposition occurs in approximately 50% of the population, but I have only seen one patient in whom the primary surgeon identified malposition and made an attempt to deal with it.

This secondary rhinoplasty patient had lateral crural malposition preoperatively.[8] She was treated before the entity was described. Preoperative views show deepening of the alar grooves and nostril distortion after loss of external valvular support. The middle vault collapse and maxillary retrusion are the consequences of a coexistent septal collapse.

Fifteen-month postoperative views after resection and relocation of the lower lateral cartilage lateral crura, Gore-Tex maxillary augmentation, and dorsal, spreader, and tip grafts are also shown.[8] Coronally oriented composite grafts were placed to complete the nostril reconstruction. Airflow increased 11 times over preoperative measurements. Note the change in alar base configuration conferred by lateral crural relocation. The alar notches have disappeared. A collapsed midvault and the external valvular deformities associated with lateral crural malposition occur together so frequently that I believe they are the face of secondary rhinoplasty today.



These photographs show the technique of resection and replacement of malpositioned lateral crura used in most patients.[8] The resected lateral crus is divided at the lateral genu (if severely deformed) or rotated downward as a flap through an infracartilaginous incision 3 mm above the rim. The resected crus is trimmed to the correct dimensions, electing the areas with the best contours, and placed along the alar rim. In the simplest cases, the lateral crus can be resected and replaced along the rim, or the rim can be splinted with cartilage or bone that spans the area of collapse. In more difficult cases, not only do the distorting lateral crura remnants have to be removed to correct the surface deformities, but the contracted vestibular skin must be replaced by composite grafts that restore the alar rims down to their normal height.[4,10]

Failure to diagnose lateral crural malposition leads to alar wall instability and external valvular obstruction. If the soft tissues are thin enough, the rim will retract cephalad, requiring tissue replacement with composite skin/cartilage grafts from the ear.

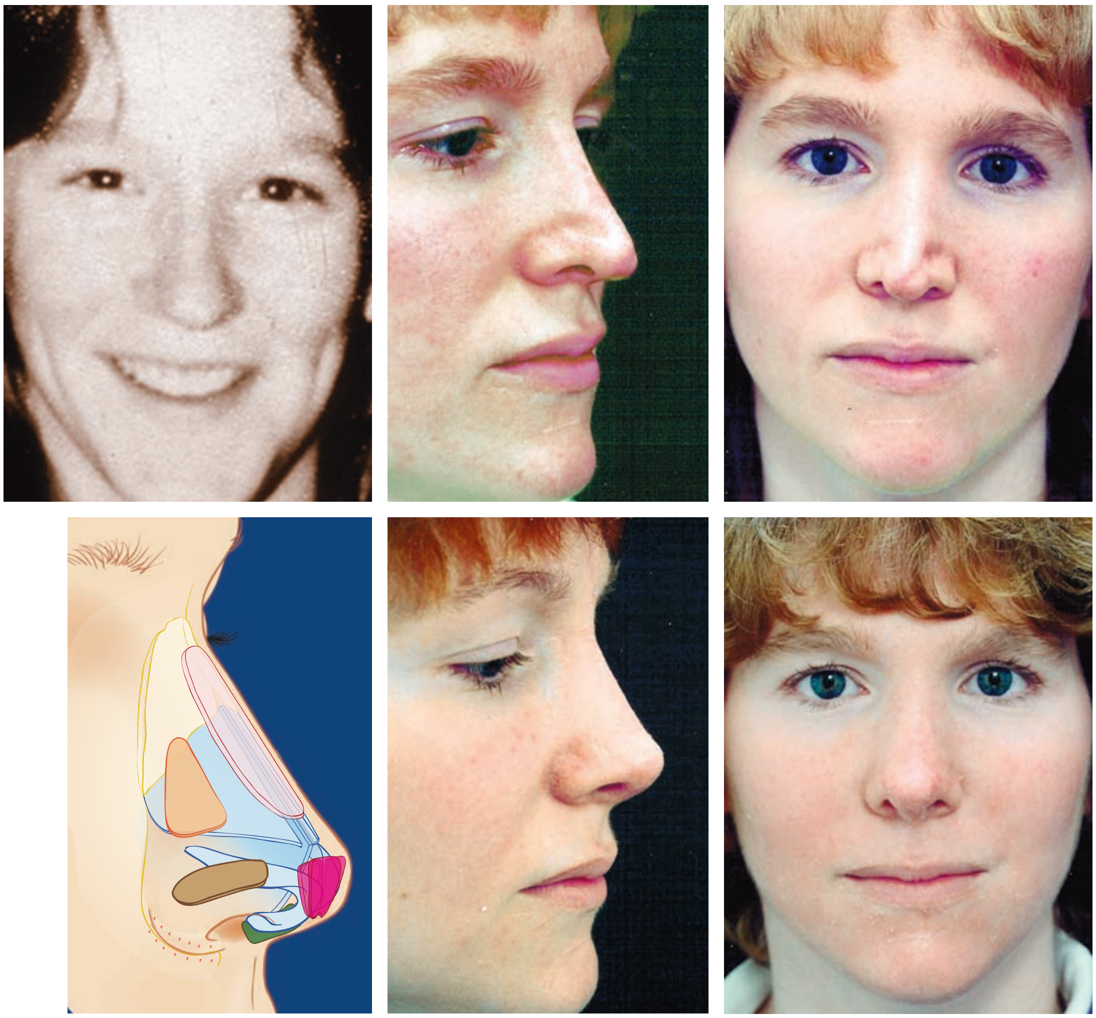
SECONDARY RHINOPLASTY DONOR SITES

Nasal Septum

Septal cartilage is the most plastic of the autologous donor sources, and use can be made of virtually every component of the nasal septum, both cartilaginous and bony. Where not enough cartilage exists, bone can be used for spreader grafts, lateral wall or alar contour grafts, and in some cases dorsal grafts (for example, where the ethmoid is the only flat bone that can be harvested and the patient needs only 1 to 2 mm of dorsal augmentation).

Septal cartilage is the most plastic of the autologous donor sources, and use can be made of virtually every component of the nasal septum, both cartilaginous and bony.

Even septal cartilage, however, can produce visible or palpable postoperative irregularities. The cartilage should be contoured or modified (by crushing) to fit the soft tissue cover, as discussed in Chapter 67. The edges can be beveled and the corners trimmed with a scalpel. Every dorsal graft must feel perfectly smooth once it is placed. If careful attention is paid to the technical details, dorsal augmentation can feel natural and undetectable.

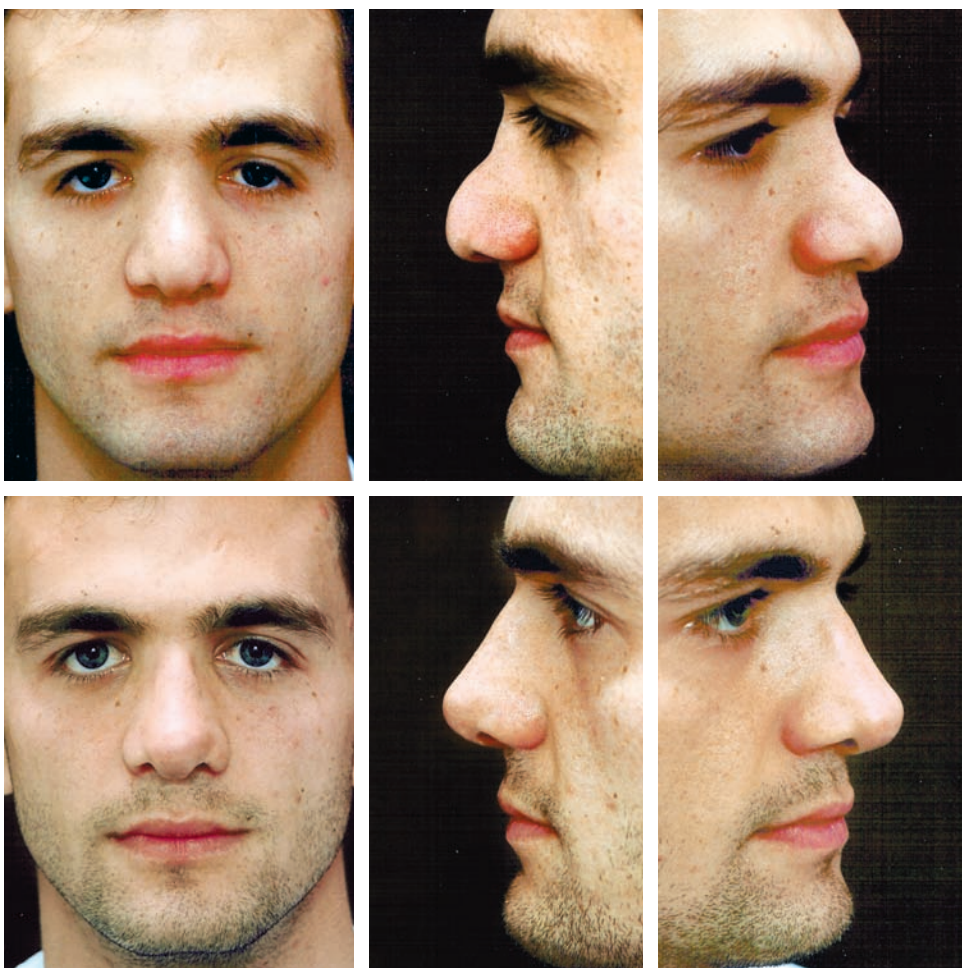


These photographs demonstrate nostril and external valvular distortion after two open rhinoplasties.[11] The 30-year-old patient is shown before any surgery. A low radix and narrow middle vault are evident. Five year postoperative views (after treatment in 1991) following maxillary augmentation, and dorsal and tip grafts using tangentially split, crushed ear cartilage are also shown. At 14 months postoperatively, geometric mean airflow had increased 114 times over preoperative values (a figure that is artificially high because of the patient's negligible preoperative flow). Septal cartilage makes excellent tip grafts; when used in solid form, the grafts create projection, and when used crushed, they create contour.

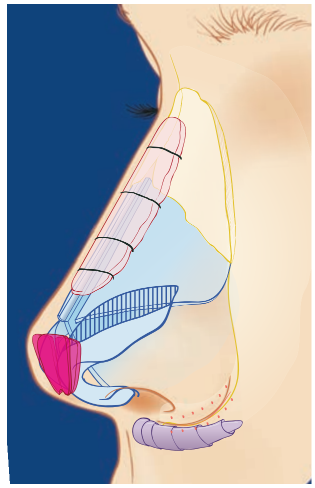
Conchal Cartilage

Unmodified cartilage from the conchal floor supplies excellent grafts for the dorsum, lateral walls, tip, or internal valves. When harvesting the cartilage, it is important to leave the posterior wall intact so that the ear does not flatten closer to the head. I prefer an anterior approach because the skin and perichondrium are thinner than on the posterior side so I can better judge the exact shape and size of what I am harvesting.

Softened or crushed, sometimes tangentially split cartilage from the conchal floor supplies excellent grafts for the dorsum, lateral walls, or internal valves. Conchal cartilage can be used as a compromise for tip grafts, but is more likely to become visible later, particularly under thin skin.



The photographs include the following views: preoperative and 6 month postoperative frontal, lateral, and oblique views.

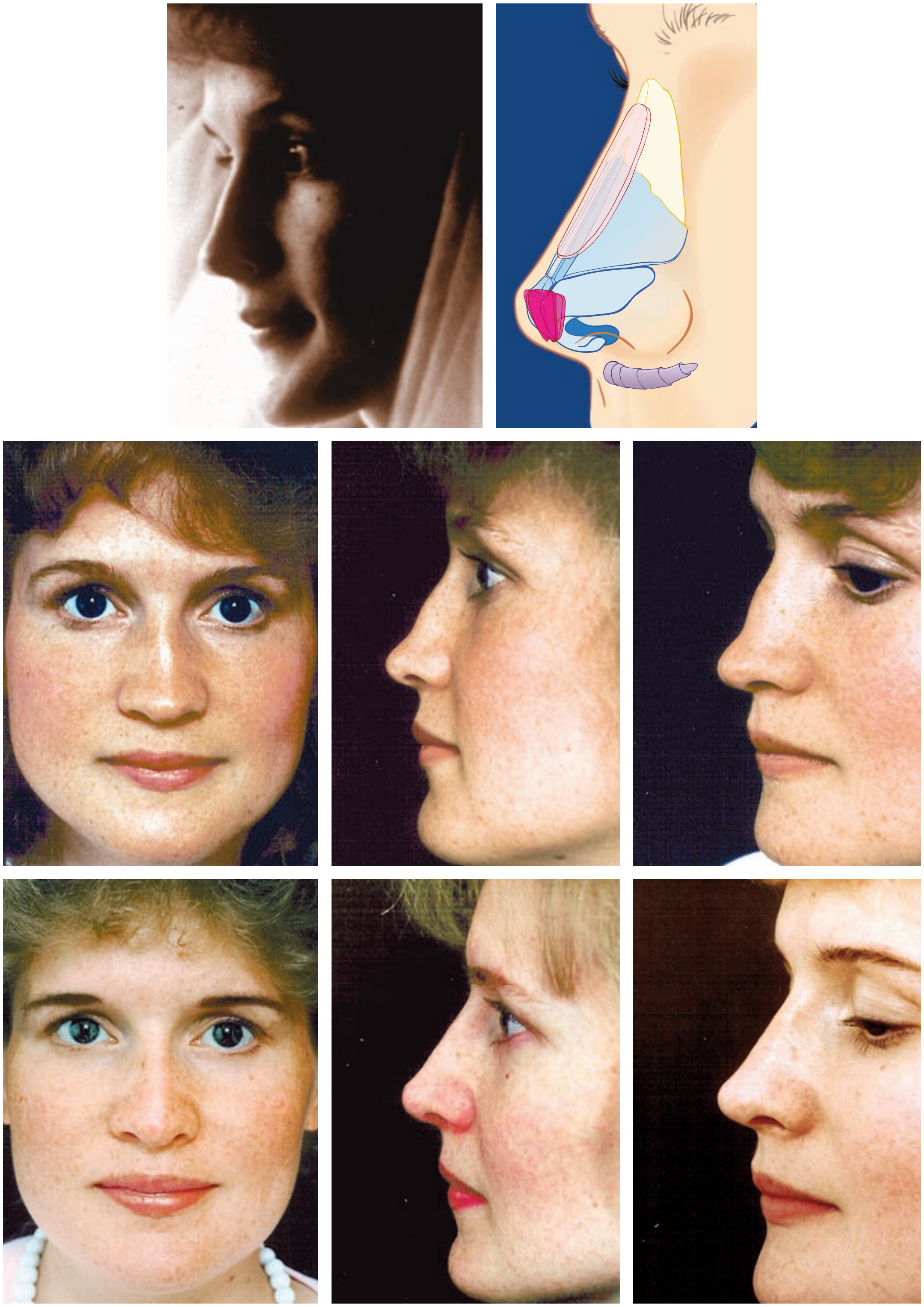


The secondary rhinoplasty patient shown on p. 820 had internal valvular incompetence from a previous dorsal resection.[12] Reconstruction consisted of maxillary augmentation, a rolled conchal cartilage dorsal graft, and tip grafts. The schematic diagram demonstrates the surgical correction.

For dorsal augmentation, conchal cartilage is best suited for deep, asymmetrical defects beneath a thick soft tissue cover. The method of trimming, rolling, and fixing the graft has been described by Sheen and Sheen.[7] For shorter, shallower defects, or under a thinner soft tissue cover, it is possible to use conchal cartilage successfully if it is split tangentially and lightly crushed. However, this is a compromise solution, and the patient must understand preoperatively.

I use crushed conchal cartilage only under rare circumstances at the nasal root, and I do not recommend using it as a string of segmental grafts to cover the dorsum, or cutting and stacking the graft, as can be done easily with septal cartilage. The aesthetic results are poor from these techniques, and their earlier advocates have stopped using them. Full-thickness ear cartilage is thick, rubbery, and elastic, and very often reveals its edges postoperatively.

Calvarial Bone

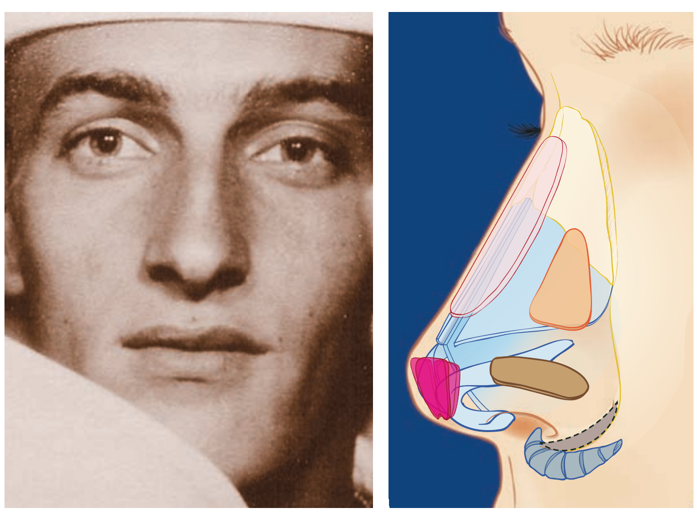


Shown first above are a preoperative oblique view and a schematic of this patient's surgical correction following septoplasty and septal collapse.[12] Preoperative and

1-year postoperative frontal, lateral, and oblique views are also shown. The outer table of the calvarium supplies grafts that are well suited for the reconstruction of long, shallow (2 to 3 mm), symmetrical dorsal defects beneath thin soft tissue covers. It is perfect for augmenting Asian and black noses, or for reconstruction following septal collapse. These grafts must be harvested with exceeding care, because intracranial injuries have been described.[13] I used calvarial bone 50 times before I became more familiar with rib cartilage and now use it only rarely when the patient, for one reason or another, does not want a rib graft. I followed all of my calvarial bone patients for at least 1 year, and I have many patients who have now been followed for more than 5 years, and a significant number who have been followed for more than 10 years after augmentation, and the grafts have survived completely. Some surgeons have been discouraged by their long-term results because of absorption but I have encountered this in only two patients in whom there was partial absorption in the supratip. Other surgeons have reported success similar to mine with even larger series.[14] Technique is critical to ensure survival. The graft must be harvested under low speed using an electric burr and cold chisel, cooling the bone constantly with saline solution.

The outer table of the calvarium supplies grafts that are well suited for the reconstruction of long, shallow (2 to 3 mm), symmetrical dorsal defects beneath thin soft tissue covers. Carefully harvested, long term survival can be expected.

Costal Cartilage



A 54-year-old tertiary rhinoplasty patient, seen here as a young man before any surgery, presented with a dorsal silicone prosthesis and notched, asymmetrical alar rims, and a tip deformity typical of preexisting alar cartilage malposition.[12]

Note the cephalic axis of the lateral crura before primary rhinoplasty (p. 823) compared with his preoperative views. The patient is seen 25 months after removal of the prosthesis and reconstruction. Costal cartilage augmented the dorsum, maxillary arch, lateral walls, and tip. A unilateral composite graft was used to correct valvular incompetence and alar rim asymmetry (coronal orientation). Airflow increased 1.4 times after reconstruction.

Despite the fact that costal cartilage is available in essentially unlimited quantities and lengths, many surgeons have avoided using it because of its reputation for postoperative warping. However, it is common to see secondary rhinoplasty patients who have had cartilage from the septum and one or both ears already harvested and need dorsal, lateral wall, tip, and maxillary augmentation, and costal cartilage will supply all of these requirements, whereas calvarial bone cannot be used in the tip, and less easily in the lateral walls or maxillary arch.

The surgeon should use the smallest rib needed to correct the deformity so that less modification and therefore less disruption of internal stresses will occur. In the past I have successfully used Gunter's method of spearing the graft with a threaded, longitudinal K-wire as an internal splint[15] but no longer do so, because it has been unreliable in my hands. A rib's biological forces are strong enough to pull it away from one, or even two, axial K-wires.

Depending on the character of the rib, which varies with patient age, the grafts can be fashioned from whole rib, split or tangential sections, unmodified, cross-hatched, or crushed, often leaving perichondrium as soft tissue cover; and the versatility of those strips, either alone or in layers, has now made it less necessary to use the wire. In patients older than approximately 40 years of age, whose ribs are more calcified and therefore stiffer, my preferred graft is a perichondrial/cartilage strip of the proper thickness, which can supply a straight dorsal graft with a smooth, convex surface. Patience, attention to detail, and experience, however, are required to use rib predictably. In a recent review of 150 consecutive patients in whom I had used rib grafts, the incidence of postoperative distortions or visible edges decreased from 25% in the first 50 patients to 10% in the last 100. This is still a high number, and the rib needs further evaluation as an augmentation material.[15]

The surgeon should use the smallest rib needed to correct the deformity so that less modification and therefore less disruption of internal stresses will occur.

The older the patient, the more calcified, and therefore reliable, the rib becomes as a graft.

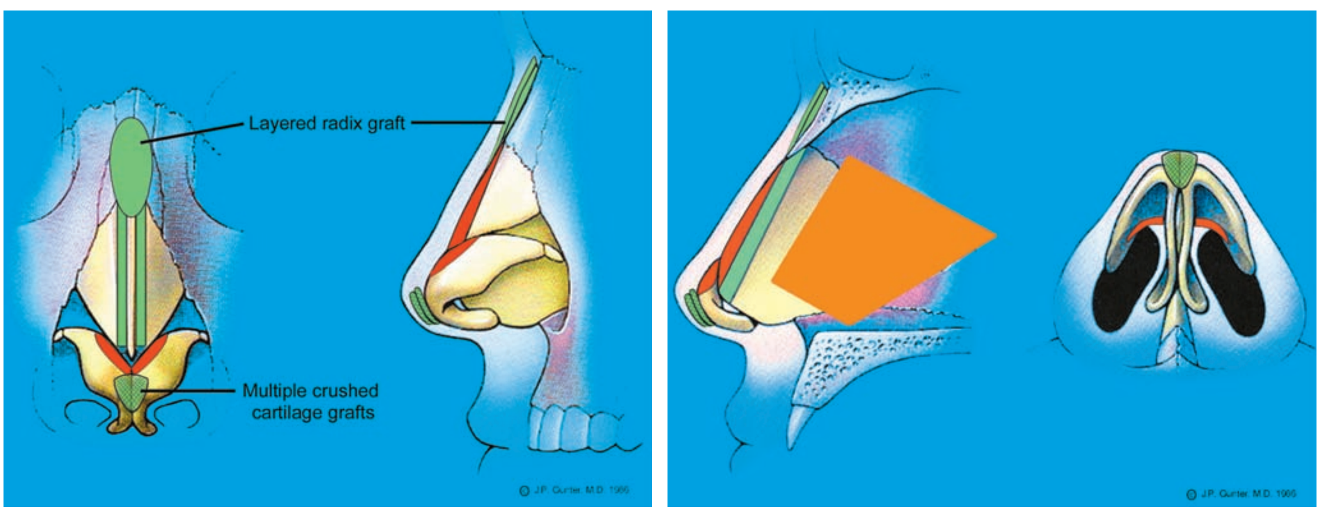
THE DONOR SITE–DEPLETED PATIENT

A donor site–depleted patient is the perfect candidate for closed rhinoplasty, because dissection can be limited to yield the most improvement from the least building material. In a previous series,[4] 17% of primary rhinoplasty patients had nasal septa that were at least 75% bony and supplied insufficient donor material. The incidence is much higher in secondary patients, many of whom have already had extensive septoplasty. The following principles are helpful in such patients: (1) internal valvular reconstruction can be accomplished by either spreader grafts or dorsal grafts with equivalent functional effects, (2) external valvular reconstruction can be accomplished by battens of cartilage or bone, or by composite skin/conchal cartilage grafts, (3) tip reconstruction may be accomplished by selectively grafting the skeletally deficient lobular parts using crushed grafts in limited pockets,[4,16] and (4) multiple staggered grafts can create a smooth dorsum in patients with an adequately thick soft tissue cover.

The donor site–depleted patient is the perfect candidate for closed rhinoplasty, because dissection can be limited to yield the most improvement from the least building material.

In this patient, the septum and portions of both ears had previously been harvested. Fortunately, her soft tissue cover was thick enough that tangentially split crushed ear cartilage and its surrounding fibrous tissue placed in the cephalic portion of the dorsum and tip lobule improved overall nasal balance and obtained the tip lobular shape that the patient desired.

Crushed ear cartilage is not a prime donor material and is not recommended in patients with medium thickness or thin soft tissue cover. However, the surgeon must always choose among the available alternatives. This patient required only 2 mm of dorsal augmentation and some tip refinement; rib grafts were unwarranted and calvarial grafts were unnecessarily risky. In some cases the desired improvement can be obtained with minimal graft material if the soft tissue cover is adequately thick and the surgeon is fortunate enough (as I was in this case) to obtain sufficient amounts of usable autologous tissue.


Layered radix graft
Multiple crushed cartilage grafts

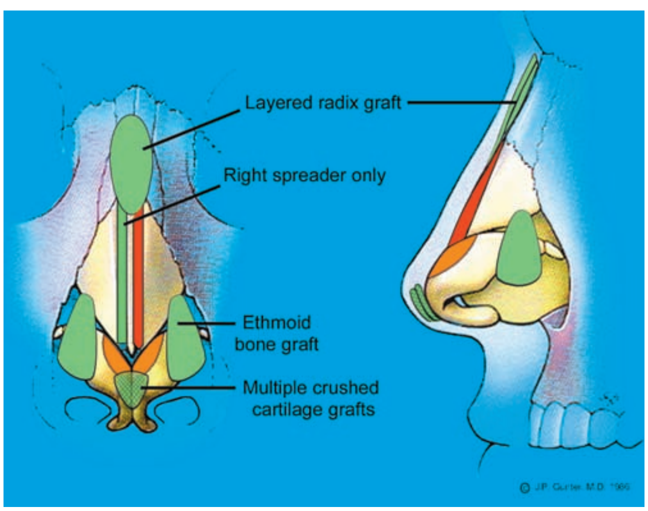
The preoperative configuration of this patient closely resembles that of the patient shown on p. 827. Note the low radix, high dorsum, and blunt, poorly defined tip with medium-thickness soft tissue cover. In the earlier patient, and despite a substantial skeletal reduction, skin sleeve volume would change very little, and contraction of the unsupported soft tissues produced the typical appearance of supratip deformity. Augmentation with dorsal and tip grafts with minimal dorsal reduction was needed to create the skeletal contours that could not be achieved by reduction alone.

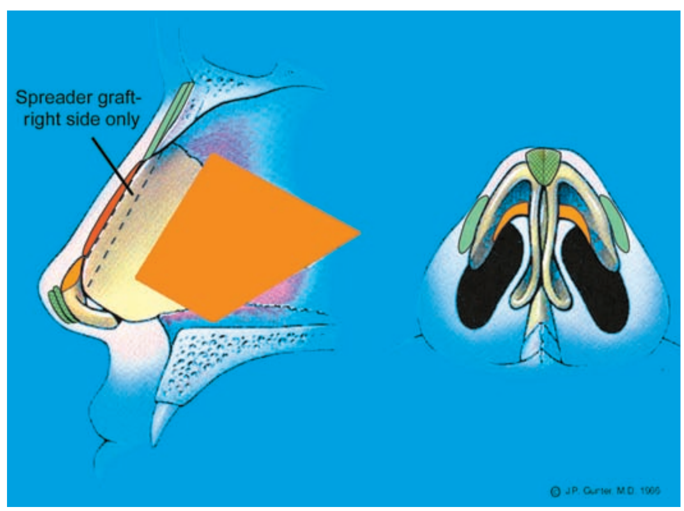
Part of the difficulty in rhinoplasty stems from two false assumptions. First, it is assumed that the skin sleeve is a passive structure that will always contract to reveal the shape of a reduced underlying skeleton (truly only to a limited degree in many noses and less true as the soft tissue cover thickens). Second, it is assumed that changes in each nasal area are regional, not global, so that each nasal area functions independently rather than interdependently.

The prior cases illustrate the fallacy of both of these assumptions. If soft tissues had the infinite ability to contract to a reduced underlying skeleton, supratip deformity would not occur, and augmentation would not correct it. If each nasal region functioned independently, skeletal reduction would not also produce an apparent increase in nasal base size, loss of support to the internal valves, and an alteration in nostril contour and columellar position.

The surgeon must be wary of triggering unexpected sequelae through failure to recognize the limitations of two classic—but false—assumptions about reduction rhinoplasty.

Part of the difficulty in rhinoplasty stems from two false assumptions. First, it is assumed that the skin sleeve is a passive structure that will always contract to reveal the shape of a reduced underlying skeleton. Second, it is assumed that changes in each nasal area are regional, not global, so that each nasal area functions independently rather than interdependently.


Layered radix graft
Right spreader only
Ethmoid bone graft
Multiple crushed cartilage grafts


Spreader graft-right side only

SPECIALIZED GRAFTS FOR COMMON SECONDARY DEFECTS

Maxillary Augmentation

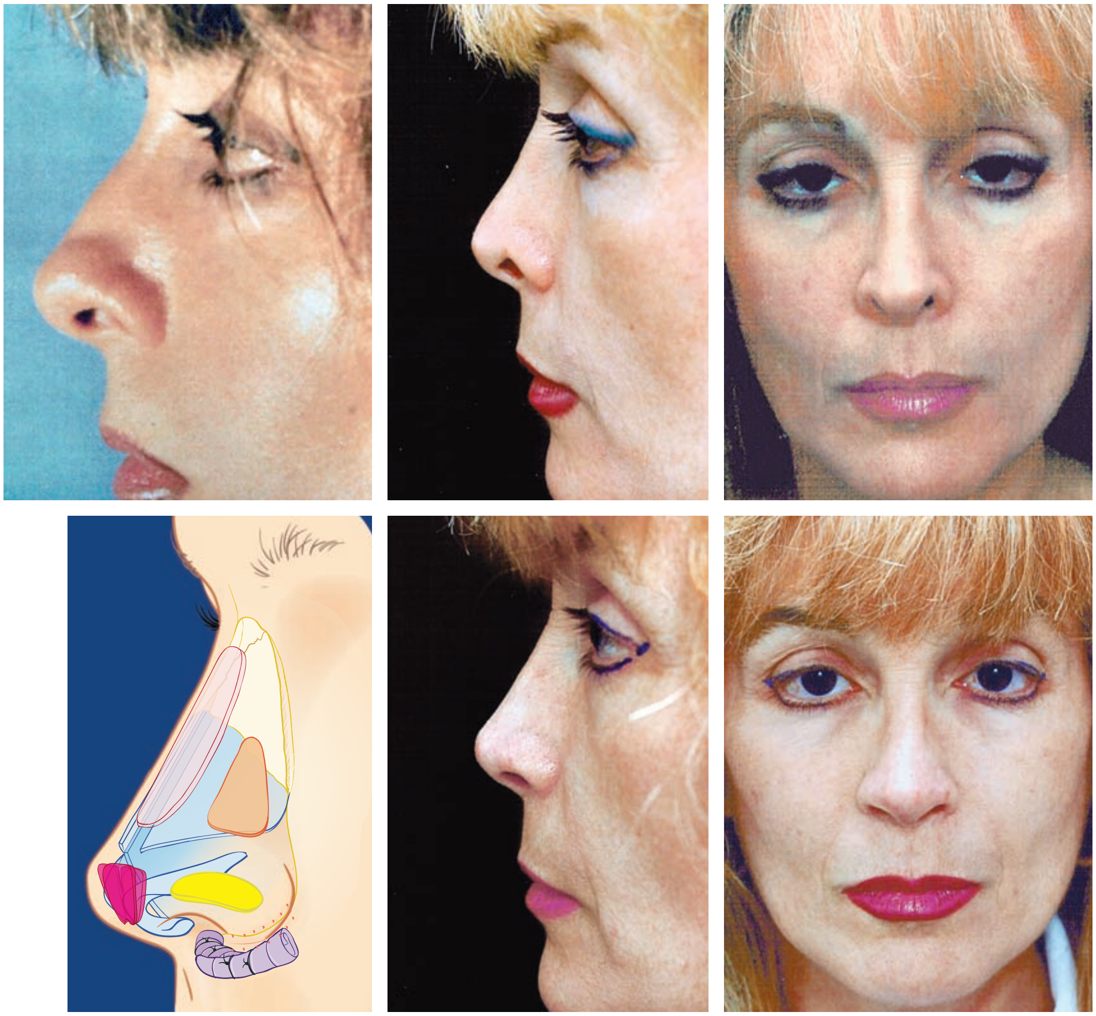
Resection of the caudal septum alters the carriage and position of the upper lip, even if the anterior nasal spine is not touched. Although this statement seems to contradict traditional teaching, it is easy to prove by observing the change in upper lip position after a patient has suffered a serious septal injury. In septal collapse, the loss of caudal septal support not only affects tip position but allows the columella to retract and the upper lip to fall posteriorly so that the subnasale becomes sharp and often depressed. More subtle examples of this same change in lip position are seen in many secondary rhinoplasty patients and can be corrected by the use of autologous or alloplastic materials.

In septal collapse, the loss of caudal septal support not only affects tip position but also allows the columella to retract and the upper lip to fall posteriorly so that the subnasale becomes sharp and often depressed.

Where rib cartilage has already been harvested for use in nasal dorsum or elsewhere, the tip of ninth or tenth rib provides an excellent maxillary augmentation and can be placed through an incision in the nasal floor. The dissection should extend subperiosteally across the maxilla, tight against the piriform aperture. The graft should be oriented and sized as necessary to fit the defect, compensating for asymmetries.

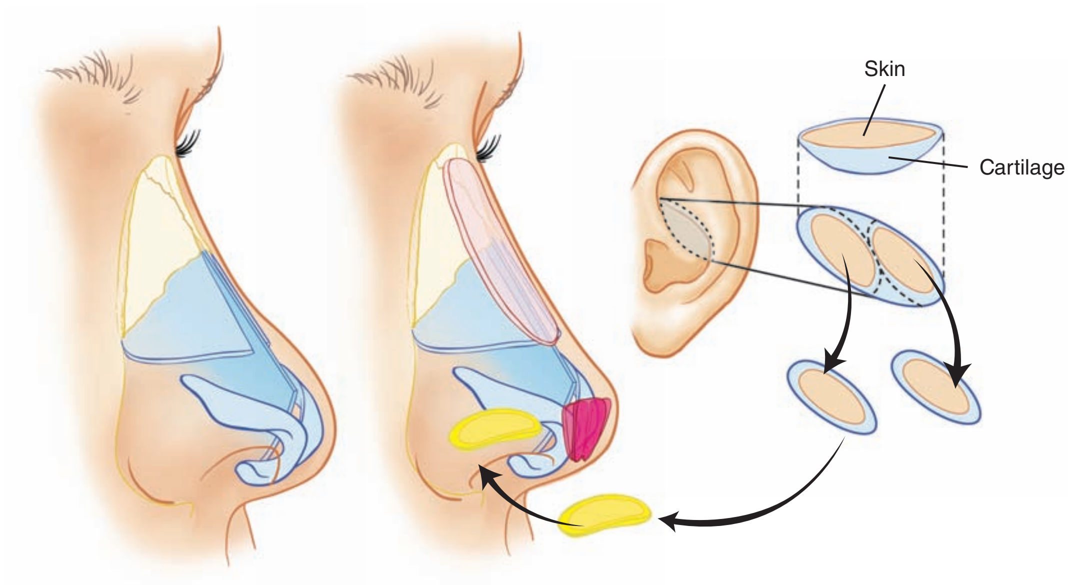
In other patients, a 1 mm subcutaneous augmentation material, Gore-Tex S.A.M. (an expanded polytetrafluoroethylene for facial use; W.L. Gore, Flagstaff, AZ), can be rolled and placed over the maxillary arch, forming an excellent augmentation material for this area. Maxillary augmentation is the only situation in which I use alloplastics in rhinoplasty, and here implants are routinely successful because they are immobile and under no tension beneath a thick, well-vascularized soft tissue cover. I have now used Gore-Tex more than 300 times in this situation, and removed it in only five patients. Three were patients with prior clefts, and I do not recommend using Gore-Tex in such cases, even if the gingivobuccal sulcus is supple and well healed. The other two implants became exposed—one by a dental procedure and the other from an unknown cause 5 years after implantation.

Composite Grafts



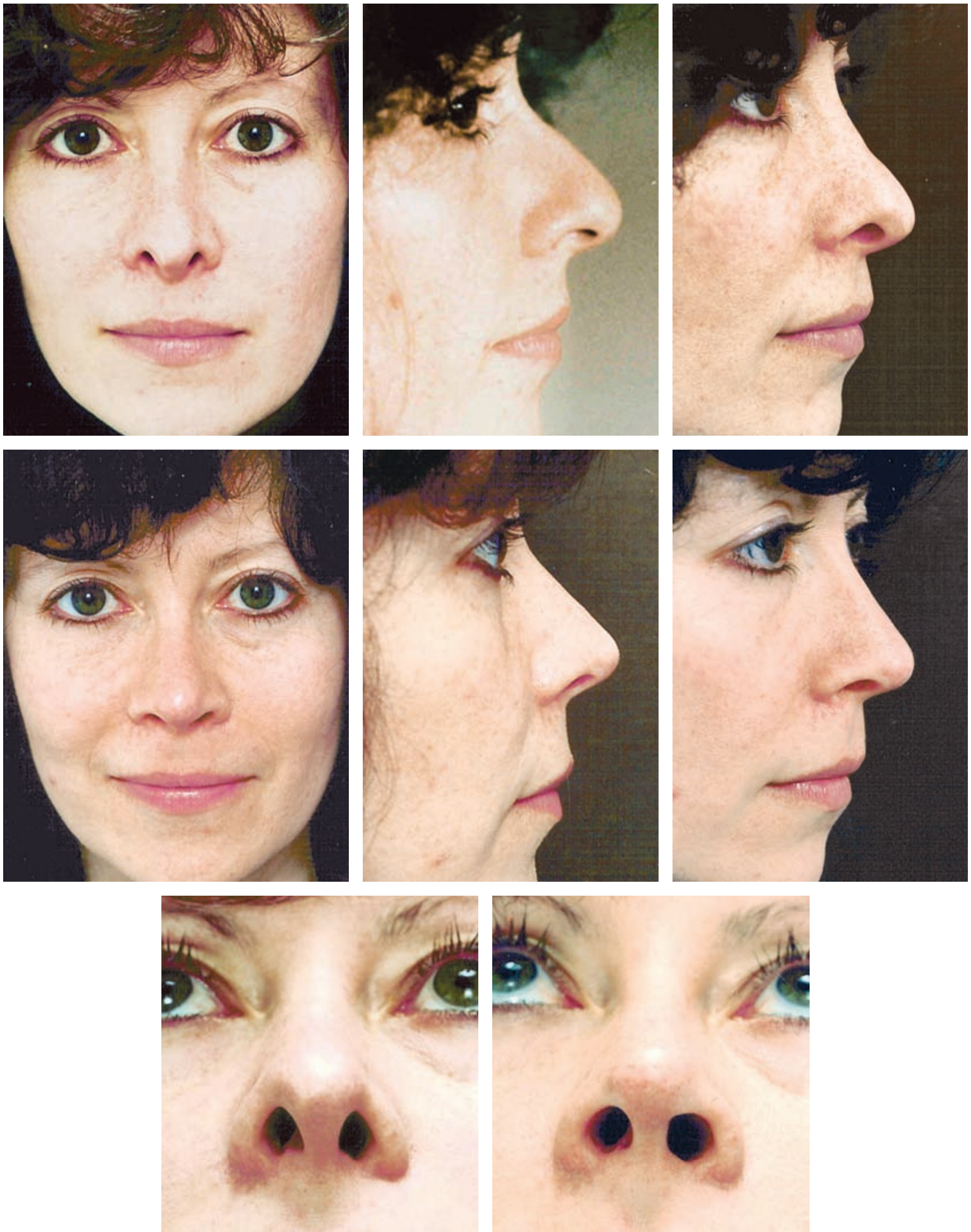
Mild forms of alar retraction can be corrected by repositioning a malpositioned lateral crus or by placement of a supporting graft. However, significant degrees of retraction represent a true skin deficit that has contracted after prior lateral crural reduction. In most of these cases the preoperative lateral crus had been malpositioned; once it was reduced in volume, the remaining crus could no longer brace the rim, which then retracted cephalad.

This 36-year-old woman presented for revision after she had undergone three rhinoplasties. She underwent staged composite grafts for marked alar retraction and external valvular incompetence.[10] She had significant alar rim retraction accompanied by external valvular incompetence. The secondary tip configuration (alar dome knuckles, rim retraction) is typical of preexisting lateral crural cartilage malposition. In addition to composite grafts (coronal orientation), septal cartilage dorsal, tip, and columellar grafts were used to increase apparent nasal length. Her result is shown 3 years postoperatively.



This tertiary rhinoplasty patient required correction of alar notching and external valvular incompetence. The illustration shows the surgical correction in which a composite conchal cartilage/skin graft was placed.

In this patient, the cartilaginous segment was used to replace the lateral crus, and the skin island corrected the vestibular skin deficiency.[2,4,10] In this procedure the graft is placed through an incision in the vestibular skin 3 mm above the alar rim. A pocket is undermined to hold the cartilaginous segment, and the skin island is precisely sutured into the vestibular defect. In this case, dorsal calvarial bone graft and conchal tip grafts were added.



The patient is shown preoperatively and 13 months postoperatively, as well as a preoperative lateral view before the first of three rhinoplasties, paired with the postoperative lateral view. Note that the original position of the lateral crus of the lower lateral cartilage does not parallel the nostril rim but is malrotated toward the dorsum.

Composite grafts taken from the cymba conchae (the donor site closed with a retroauricular graft) form an excellent solution for retracted alar rims, and they are extremely reliable. The cartilaginous component should be thinned in most cases (unless the soft tissue cover is extremely thick) so that the graft does not make the rim bulky.

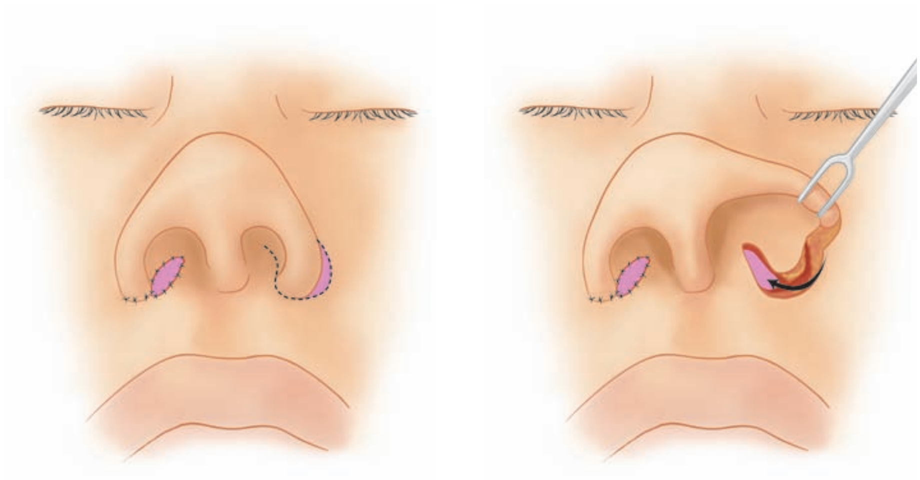
Graft placement and fixation with 6-0 sutures should be meticulous, and the nose should be packed for 7 days postoperatively. If these rules are followed, take is virtually 100%, even in noses already operated many times, or in burns.

Even more important than recognizing the indication for the composite graft is understanding the genesis of the deformity. In a review of 100 consecutive patients in whom I had placed composite grafts,[10] 80% of the deformities were caused not by trauma, tumor, or a congenital defect but by a prior cosmetic rhinoplasty, most often in patients with an unrecognized alar cartilage malposition.

Composite grafts can be placed in any one of three planes: (1) coronally (to bring down the alar rim), (2) axially (to open a nostril that has been excessively reduced), or (3) sagittally (to correct vestibular stenosis). The method has been detailed previously.[13]

Even more important than recognizing the indication for the composite graft is understanding the genesis of the deformity—in most cases, unrecognized alar cartilage malposition.

Alar Base Flap



In the above illustration of an alar base flap, the right flap has been transposed, and the left flap is marked adjacent to the alar base with its lateral margin lying in the proper location for the margin of the alar lobule and its medial margin adjacent to the alar crease.[17] The nasal floor should be opened at the site of greatest tissue deficiency. The flap has been elevated on subcutaneous and musculocutaneous perforators and will rotate into the defect, clockwise on the patient's left side and counterclockwise on the patient's right side. As the donor site is closed, the alar base assumes its proper position and the nostril inlet opens. The patient is shown preoperatively *(left)* and 2 years postoperatively *(right)*.

There are patients in whom prior alar wedge excisions produce nostril stenosis in combination with alar bases that have been displaced too far medially. Here a composite graft would only open the nostril but would not reposition the alar base. A useful solution instead is transposition of a crescent-shaped island flap on subcutaneous and musculocutaneous pedicles taken immediately adjacent to the alar base. As the flap rotates into the nasal floor, volume is restored, and as the donor site is closed, the alar base is repositioned.[4-17]

THE USE OF ALLOPLASTICS IN SECONDARY RHINOPLASTY

Although many surgeons have written enthusiastically about alloplastics or use of homologous grafts, I do not use them for three reasons. First, most reports in the literature share the characteristics of limited, incomplete patient follow-up in which success is only defined as the absence of infection or extrusion. Even when short-term data seem promising, no alloplastic material has demonstrated the success and low rate of complications that match autologous grafts. The problems of autologous grafts are partly technical (and therefore under the control of the surgeon) and partly because of the variation in human tissue that is characteristic of any surgical operation.

Second, the rationale for using alloplastic materials is always that they are convenient and do not need to be harvested. Although that is true, alloplastics are decidedly inconvenient if they do not achieve long-term results or leave the patient with a continued threat of extrusion or infection.

Third, the patient in whom the surgeon most wishes to use alloplastic materials is precisely the worst candidate for them: the tertiary rhinoplasty patient whose emotional and nasal tissue tolerance is scarred and worn, and whose best donor sites have been previously exhausted. Thin, poorly vascularized beds or cases in which the tissues need to be expanded and therefore will be under tension are poor settings for implants. Alloplastics are only convenient on the day of surgery.[4]

The patient in whom the surgeon most wishes to use alloplastic materials is precisely the worst candidate for them.

Alloplastics are only convenient on the day of surgery.

CONCLUSION

Rhinoplasty deformities follow patterns; therefore the solutions also follow patterns. The difficulty in secondary rhinoplasty is not really technical or anatomic; it is in recognizing the phenomenology present in nasal structure and function and learning to work within it.

The difficulty in secondary rhinoplasty is not really technical or anatomic; it is in recognizing the phenomenology present in nasal structure and function and learning to work within it.

The characteristics that make nasal surgery unique and difficult are shared by both primary and secondary rhinoplasty. The major differences are that the secondary patients have already had part of their nasal structures removed or modified; their soft tissues are less forgiving, donor sites may have already been used, some deformities (alar rim retraction, maxillary retrusion, nostril stenosis) occur that are less common in the primary situation, and the patient's tolerance for new problems or disappointments is lower. In secondary rhinoplasty, the surgeon is not looking at what might happen if certain maneuvers are carried out or critical anatomic variants are ignored, but rather seeing what has happened; that is the other side of the coin. In many cases, secondary rhinoplasty is an operation of undoing. However, the planning is similar (recognizing anatomic variations and using soft tissue perimeters for creating a surgical plan), the strategy is similar (minimizing incisions and dissection), and preservation or reconstruction of the airway is still paramount.

A new spectrum of deformities is appearing as open rhinoplasty techniques become increasingly popular.[4] Secondary patients treated by open approaches have more deformities and a different prevalence of deformities than those previously treated endonasally. Most postopen rhinoplasty deformities involve the nasal base (nostrils, external valves, columella, and alar rims); some, like columellar widening or notching, are almost nonexistent after closed rhinoplasty. Surgeons should approach all rhinoplasty techniques—open or closed—with caution and judicious skepticism. The results shown by experts may not typify those that can be obtained by the occasional rhinoplasty surgeon. There is a real need for more good outcome studies and complication reporting. No procedure is flawless.

A new spectrum of deformities is appearing as open rhinoplasty techniques become increasingly popular. Secondary patients treated by open approaches have more deformities and a different prevalence of deformities—particularly ones involving the nostrils, external valves, columella, and alar rims—than those patients previously treated through a closed approach.

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Surgeons should approach all rhinoplasty techniques—open or closed—with caution and judicious skepticism. The results shown by experts may not typify those that can be obtained by the occasional rhinoplasty surgeon. There is a real need for more good outcome studies and complication reporting. No surgical procedure is flawless.

Finally, surgeons should remember that the most common patient motivation for secondary rhinoplasty (89% in my series of 150 patients)[4] is an iatrogenic deformity from the previous surgery (or surgeries): a new deformity, an uncorrected deformity, or the intolerable loss of a personal or familial characteristic—an unacceptable change.[18] The surgeon who undertakes secondary rhinoplasty assumes an important responsibility. Nevertheless, with appropriate motivation and experience, the surgery can be uniquely rewarding and gratifying to patient and surgeon.

The most common patient motivation for secondary rhinoplasty is an iatrogenic deformity from the previous surgery (or surgeries). The surgeon who undertakes secondary rhinoplasty assumes an important responsibility.

KEY POINTS

- Successful primary rhinoplasty is the key to successful secondary rhinoplasty.
- The only deformities or anatomic variations that are important are those that distort the surface or obstruct the airway.
- There is no difference between primary and secondary rhinoplasty except the donor sites.
- The more difficult the case, the more limited the donor material, the more scarred the soft tissue cover, and the more valuable it is to limit dissection, the greater the advantage of the closed approach.
- Secondary rhinoplasty deformities are not limitless; they form one of three patterns: deformities from soft tissue contraction, deformities from skeletal contraction, and deformities from imbalance. Thus the solutions follow patterns.

- Since they have already invested money, time, discomfort, and emotion in one or more unsuccessful procedures, what secondary patients fear most and need least are additional disappointments.
- Four distinct differences separate primary and secondary rhinoplasty: deformity patterns, tissue tolerance, donor site depletion, and patient depletion.
- The patient must be guided to understand that every rhinoplasty is a compromise between the patient's aesthetic goals and the limitations that the operated skeleton and soft tissue configuration impose.
- The internal nose should always be examined first to avoid being distracted in the discussion of aesthetics.
- A patient who is still angry at the previous surgeon and cannot be convinced that the surgeon did his or her best to solve the patient's problem is not a good surgical candidate unless that misconception can be completely corrected.
- Failure to recognize a low radix or low dorsum contributes to collapse of the middle vault and a nose that appears bottom heavy. The patient often complains that the lower nose has become larger since the primary operation. The treatment is radix or dorsal grafting.
- Tip projection reflects lower lateral cartilage middle crura strength, not skin volume. This is a critical distinction.
- Failure to recognize inadequate tip projection in a primary nose usually creates supratip deformity. The patient will complain that the dorsum is still not straight or that the tip is "bigger" or has lost shape.
- Many surgeons do not know how to recognize inadequate tip projection, or use a method that is inaccurate, and others recognize it but cannot correct it.
- If the lower lateral cartilages middle crura are insufficiently strong, insufficiently large, or wide enough at the medial genu to provide a middle crus of adequate length, there is a skeletal shortage that is most effectively corrected by augmenting it.
- A narrow middle vault indicates internal valves that are often incompetent; dorsal resection will further narrow the middle third and worsen the airway. The narrow middle vault is easy to identify on internal examination, but it is sometimes not visible externally as the characteristic inverted-V deformity if the soft tissues are thick enough to obscure it. The treatment is dorsal or spreader grafts.
- Malposition occurs in approximately 50% of the population, but I have only seen one patient in whom the primary surgeon identified malposition and made an attempt to deal with it.
- Failure to diagnose lateral crural cartilage malposition leads to alar wall instability and external valvular obstruction. If the soft tissues are thin enough, the rim will retract cephalad, requiring tissue replacement with composite skin/cartilage grafts from the ear.
- Septal cartilage is the most plastic of the autologous donor sources, and use can be made of virtually every component of the nasal septum, both cartilaginous and bony.

- Softened or crushed, sometimes tangentially split cartilage from the conchal floor supplies excellent grafts for the dorsum, lateral walls, or internal valves. Conchal cartilage can be used as a compromise for tip grafts, but is more likely to become visible later, particularly under thin skin.
- The outer table of the calvarium supplies grafts that are well suited for the reconstruction of long, shallow (2 to 3 mm), symmetrical dorsal defects beneath thin soft tissue covers.
- The surgeon should use the smallest rib needed to correct the deformity so that less modification and therefore less disruption of internal stresses will occur.
- The older the patient, the more calcified, and therefore reliable, the rib becomes as a graft.
- The donor site–depleted patient is the perfect candidate for closed rhinoplasty, because dissection can be limited to yield the most improvement from the least building material.
- Part of the difficulty in rhinoplasty stems from two false assumptions. First, it is assumed that the skin sleeve is a passive structure that will always contract to reveal the shape of a reduced underlying skeleton. Second, it is assumed that changes in each nasal area are regional, not global, so that each nasal area functions independently rather than interdependently.
- In septal collapse, the loss of caudal septal support not only affects tip position but also allows the columella to retract and the upper lip to fall posteriorly so that the subnasale becomes sharp and is often depressed.
- Even more important than recognizing the indication for the composite graft is understanding the genesis of the deformity.
- The patient in whom the surgeon most wishes to use alloplastic materials is precisely the worst candidate for them.
- Alloplastics are only convenient on the day of surgery.
- The difficulty in secondary rhinoplasty is not really technical or anatomic; it is in recognizing the phenomenology present in nasal structure and function and learning to work within it.
- A new spectrum of deformities is appearing as open rhinoplasty techniques become increasingly popular. Secondary patients treated by open approaches have more deformities and a different prevalence of deformities—particularly ones involving the nostrils, external valves, columella, and alar rims—than those patients previously treated through a closed approach.
- Surgeons should approach all rhinoplasty techniques—open or closed—with caution and judicious skepticism. The results shown by experts may not typify those that can be obtained by the occasional rhinoplasty surgeon. There is a real need for more good outcome studies and complication reporting. No surgical procedure is flawless.
- The most common patient motivation for secondary rhinoplasty is an iatrogenic deformity from the previous surgery (or surgeries). The surgeon who undertakes secondary rhinoplasty assumes an important responsibility.

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Harvesting Rib Cartilage Grafts for Secondary Rhinoplasty

C. Spencer Cochran ▪ Jack P. Gunter

Reconstruction of the nasal osteocartilaginous framework is the foundation of successful secondary rhinoplasty. Achieving this often requires large quantities of cartilage to correct contour deformities and functional problems caused by previous procedures. Satisfactory and consistent long-term results rely on the use of grafts with low resorption rates and sufficient strength to offer adequate support. Autologous tissue is always preferred in secondary rhinoplasty, because the use of alloplastic material increases the rate of infection or extrusion.

Autologous tissue is always preferred in secondary rhinoplasty, because the use of alloplastic material increases the rate of infection and/or extrusion.

BACKGROUND

There are five potential donor sites for autologous grafts in secondary rhinoplasty: septal cartilage, auricular cartilage, rib cartilage, and iliac or calvarial bone. The septum is the preferred source in secondary rhinoplasty because it requires no additional incisions, there is no significant donor site morbidity, and its harvest may correct septal deviations and improve the airway. Unfortunately, the quantity of septal cartilage available is frequently insufficient, which mandates the use of alternative donor sites. Ear cartilage is used occasionally but is less successful when structural support is mandatory. Bone is rarely used because of its variable postoperative resorption. The rib provides the most abundant source of cartilage for graft fabrication and is the material of choice when reliable structural support is needed.

The septum is the preferred source in secondary rhinoplasty because it requires no additional incisions, there is no significant donor site morbidity, and its harvest may correct septal deviations and improve the airway.

INDICATIONS AND CONTRAINDICATIONS

The rib offers an abundant supply of cartilage for use in virtually every aspect of secondary rhinoplasty and is the preferred donor site when rigid support or moderate augmentation is necessary. The most significant advantage of rib cartilage is that grafts can be produced with considerable versatility with respect to shape, length, and width, thereby facilitating reconstruction of the nasal framework in patients with all types of functional and aesthetic requirements.

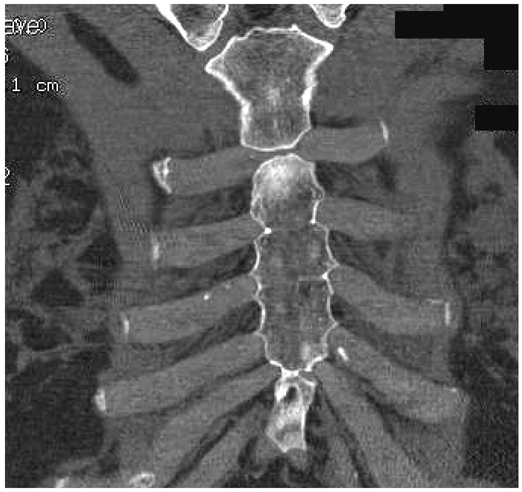
However, use of rib cartilage has several disadvantages. An additional incision at a distant donor site is required to harvest the cartilage. Fortunately, the resulting scar is relatively short (approximately 5 cm) and is generally inconspicuous in women because of its placement under the breast. Postoperative pain, the risk of pneumothorax, and the potential for rib cartilage to warp are other limitations. The latter may lead to long-term postoperative distortions of nasal shape.

PREOPERATIVE ASSESSMENT AND PLANNING

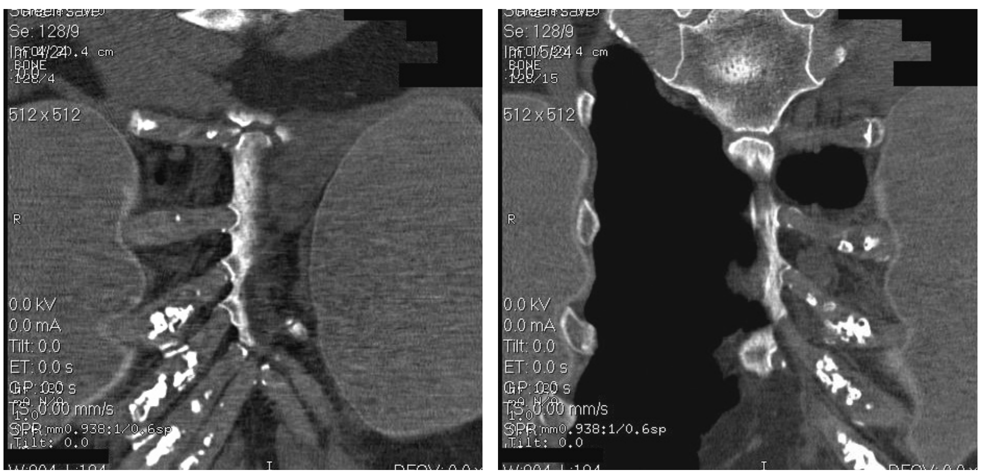
Rib cartilage harvesting is preferentially performed on the patient's left side to facilitate a two-team approach. Marking is initiated by palpating the sternomanubrial joint, which indicates the position of the second rib. The ribs are then palpated and numbered according to their position.

The fifth, sixth, and seventh ribs are the ones most often selected for harvest.

The amount of cartilage required dictates whether the cartilaginous segment from one rib, one rib and a portion of another, or the entire cartilage segments of two ribs need to be harvested. In general, one should choose the cartilaginous portion of a rib that provides a straight segment with sufficient cartilage to fabricate all grafts. It is often possible to construct all required grafts from the cartilaginous portion of a single rib. If additional grafts are needed, a part or the entire cartilaginous portion of a remaining rib may be harvested.

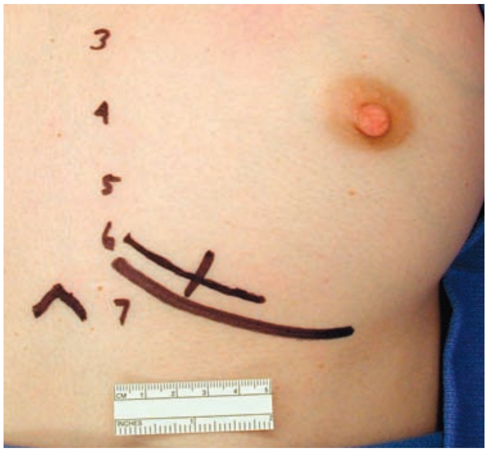


In older patients, ossification of the cartilaginous rib is a significant concern. Therefore a limited CT scan of the sternum and ribs is recommended in patients in whom there is a high index of suspicion for ossification. This CT scan shows normal rib cartilage with limited calcification.

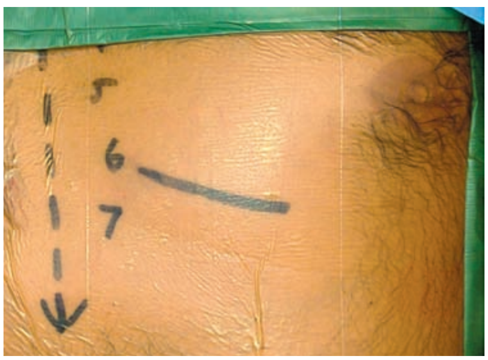


Experienced radiologists can determine the extent of calcification in the cartilaginous rib, which will indicate the likelihood of success with a rib grafting procedure. The above CT scans show calcified rib cartilage on the right and left sides. In our office, we commonly order a limited CT scan of the sternum with a special request for axial images of the sternum and sternocostal junctions with coronal reformations.

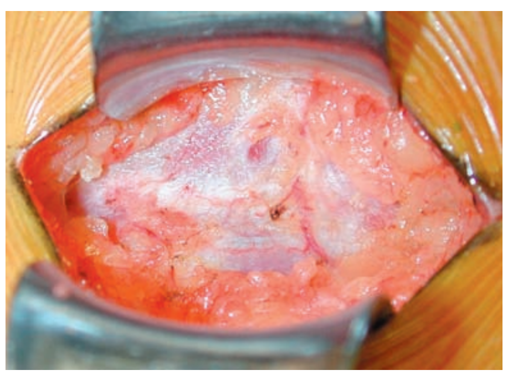
OPERATIVE TECHNIQUE



In female patients, the incision is marked approximately 5 mm above the inframammary fold and measures 5 cm in length. The incision should not extend beyond the medial extent of the inframammary fold. This avoids postoperative visibility of the incision if the patient wears clothing with a low-cut neckline.



In male patients, placement of the incision is not as important, unless there is a hair-bearing area in which the incision can be camouflaged. If not, the incision is usually placed directly over the chosen rib to facilitate the dissection.

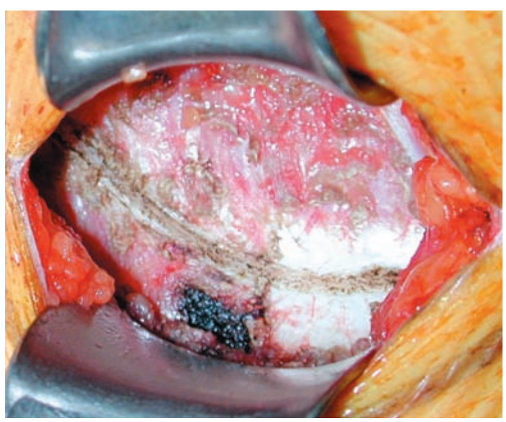


The harvesting procedure begins by incising the skin over the desired rib with a No. 15 blade and dissecting through the subcutaneous tissue using electrocautery. If the patient has had a previous breast augmentation with an implant, it is best to avoid entering the capsule or exerting undue pressure superiorly for fear of rupturing the implant. Gentle retraction can be used to displace the implant during the dissection. It is generally prudent to try to harvest ribs that are more

distant from the capsule first. If the capsule is violated, extensive irrigation of the pocket with an antibiotic solution and careful closure with absorbable sutures is recommended.

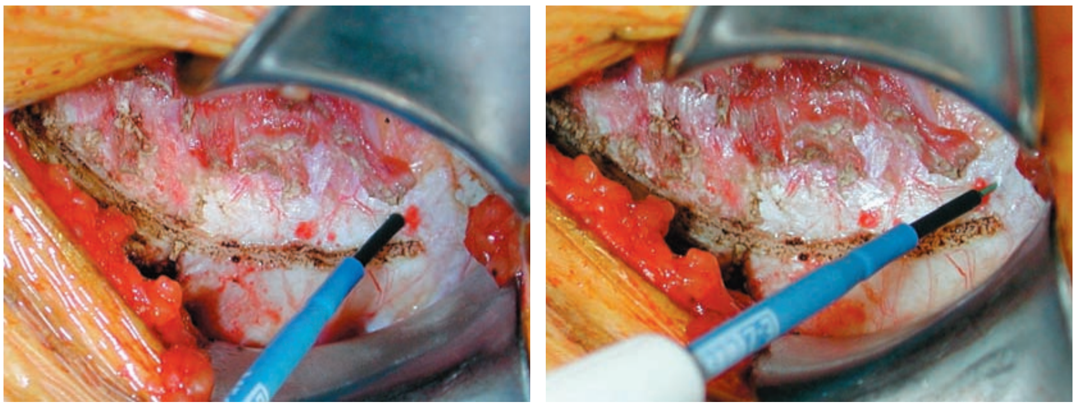
Once the muscle fascia has been reached, it is important to palpate the underlying ribs to ensure that the dissection proceeds directly over the longitudinal axis of the chosen rib.

Knowing the position of both bony-cartilaginous junctions is important to ensure that the maximum length of each rib is harvested, thereby optimizing the efficiency of the procedure.

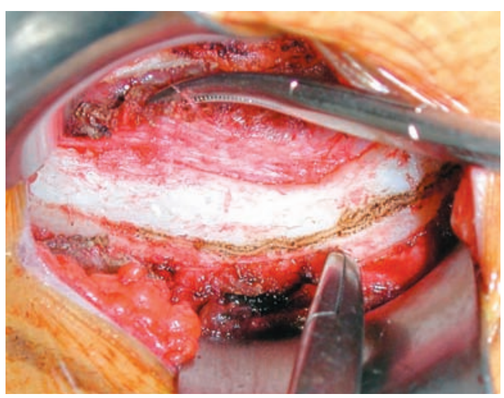


After exposing the selected rib, a longitudinal incision is made through the perichondrium along the length of the central axis of the rib. Perpendicular cuts are also made at the most medial and lateral aspects of the cartilaginous rib to facilitate reflection of the perichondrium.

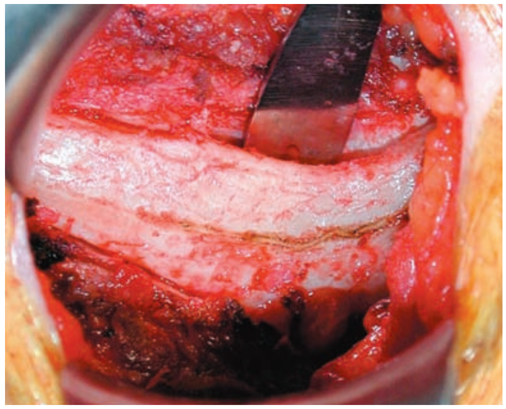
The dissection should be carried medially until the junction of the rib cartilage and sternum can be palpated. The lateralmost extent of the dissection is demarcated by the costochondral junction. Identification of the junction is facilitated by the subtle change in color at the interface; the cartilaginous portion is generally off-white, whereas the bone demonstrates a distinct reddish-grey hue. In older patients the cartilage tends to be more yellow and friable, often with focal calcifications.



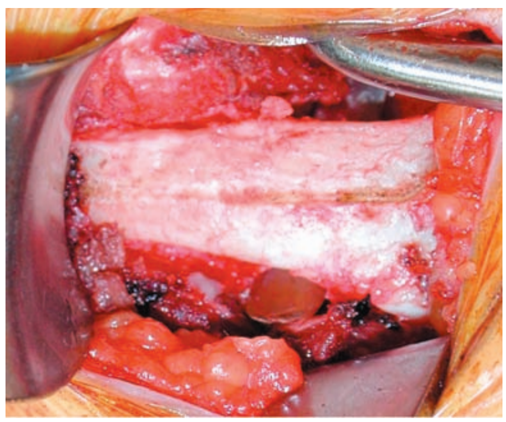
To ensure the position of the lateral bony-cartilaginous junction, the sharp point of a Bovie needle is pressed against the anterior surface of the rib. It will easily penetrate into cartilage but not bone. These images show penetration and nonpenetration of the Colorado needle into bone.



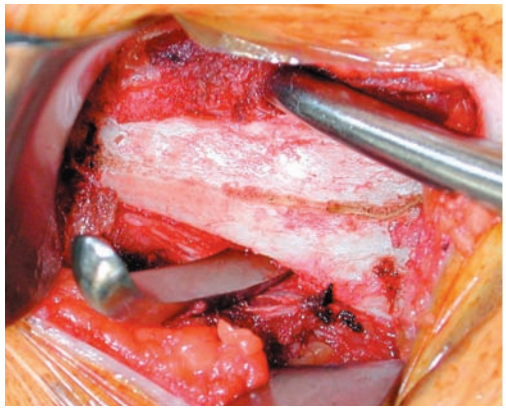
The perichondrial flap is reflected superiorly with a hemostat. A Dingman elevator is used to elevate perichondrial flaps based on the superior and inferior borders of the rib cartilage.



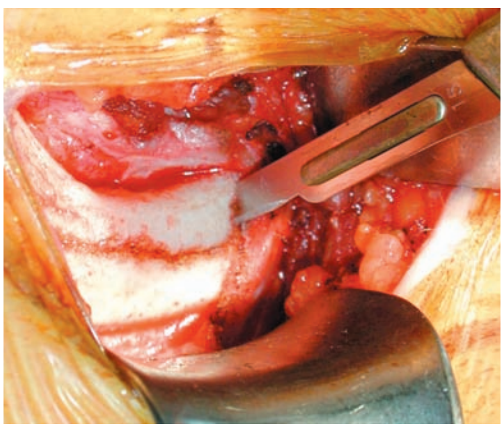
The dissection is then continued subperichondrially until the posterior aspect of the rib is exposed. During elevation, the perichondrium may become tight and limit further dissection. If this occurs, it is useful to perform additional perpendicular "back-cuts" on the anterior surface of the perichondrial flap to release tension. Perichondrial elevators are then employed to release the posterior adherence between the cartilage and perichondrium as far as possible.



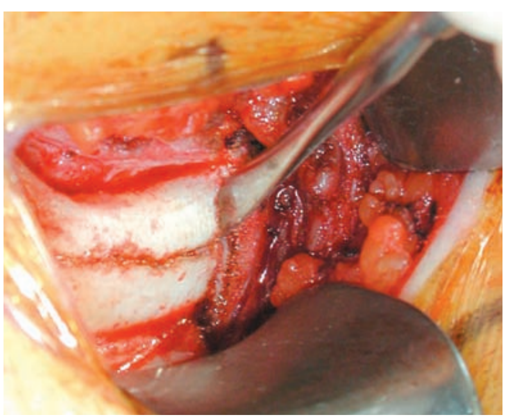
A curved rib stripper completes the posterior dissection. We have found it useful to pass the tip of the rib stripper with gentle upward force to stay within the subperichondrial space. However, care must be taken to not enter the body of the cartilaginous rib or cause a fracture, which may limit graft fabrication. The remainder of the subperichondrial dissection is generally straightforward and bloodless, as long as the perichondrium is not violated and the correct plane is maintained.



The curved rib stripper is slid back and forth along the rib, taking care to stay between the cartilage and perichondrium until the undermining is complete. Perichondrial tears should be avoided so that a tight postoperative closure can later be accomplished to help “splint” the wound, which helps to relieve postoperative pain.



The final step involves separating the cartilaginous rib from its medial attachments near the sternum and laterally at the bony rib. This is performed by making a partial-thickness right-angled incision using a No. 15 blade at the aforementioned junctions.



The separation can then be completed by inserting a curved rib stripper under the incision sites and the sharp end of a Freer elevator used with gentle side-to-side movements to complete the incision.

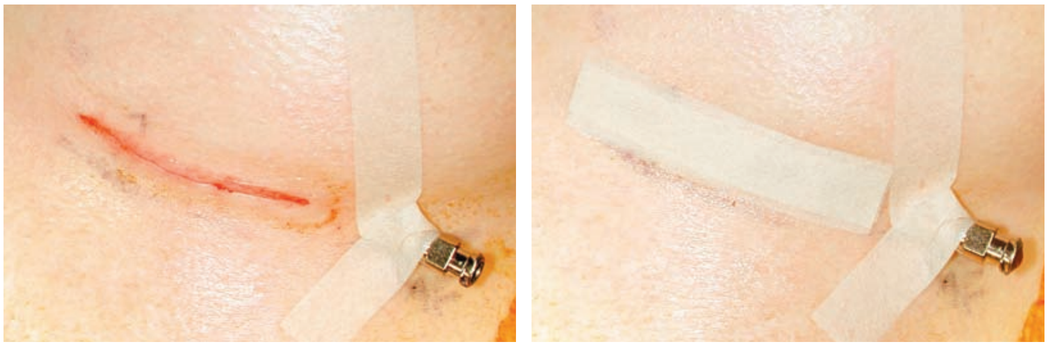
Once the cartilage segment is released both medially and laterally, the graft can be easily removed from the wound and placed in a sterile saline solution with gentamicin (50 mg/500 ml) until the surgeon is ready for fabrication. A harvested rib cartilage graft is shown above.

If more grafting material is required, a portion of cartilage or the entire cartilaginous part of another rib should be harvested. After an adjacent donor rib is chosen, access to the perichondrium is obtained by undermining deep to the existing muscle. By avoiding an additional incision through the fascia and muscle, this prevents the creation of a bridge of denervated and devascularized muscle between adjacent ribs, which may result in delayed healing at the donor site.

After the perichondrium on the anterior surface of the adjacent rib is exposed, harvesting of its entire cartilaginous portion is performed as outlined earlier. In some situations it may be sufficient to harvest only a segment of the adjacent rib. If this is the case, the perichondrium does not need to be elevated circumferentially, as previously described. Instead, the desired amount of cartilage should be defined and marked. Then a perichondrial flap is created by incising and elevating the perichondrium only over the surfaces of the marked cartilage. The chosen segment is then incised with a No. 15 blade and harvested using a sharp elevator.

After hemostasis is achieved, the donor site is checked to ensure that no pneumothorax has occurred. The wound is filled with saline solution, and the anesthesiologist applies positive pressure into the lungs. If no air leak is detected, a pneumothorax can be excluded. A 16-gauge angiocatheter is inserted through the skin and placed in the subperichondrial space. The wound may then be closed in layers. Particular attention should be directed to reapproximating the perichondrium. It is important to close the perichondrium tightly, because this layer is fairly rigid and may help to “splint” the wound and reduce postoperative pain. The angiocatheter is secured to the skin to avoid accidental removal.

Particular attention should be directed at reapproximating the perichondrium. The perichondrium should be closed tightly because this layer is fairly rigid and may help to "splint" the wound and reduce postoperative pain.



Wound closure is completed by approximating the muscle and fascial layers using 2-0 Vicryl sutures. Skin closure is carried out using deep dermal and subcuticular 4-0 Monocryl sutures. The final closure with the catheter secured and the final dressing are shown.

COMPLICATIONS

If a pneumothorax has been diagnosed, this usually represents an injury only to the parietal pleura, not to the lung parenchyma itself. Thus this does not mandate chest tube placement. Instead, a red rubber catheter can be inserted through the parietal pleural tear into the thoracic cavity. The incision should then be closed as previously described, in layers around the catheter. Positive pressure is then applied and the catheter is clamped with a hemostat until the surgeon is prepared to remove it. At the end of the operation, the anesthesiologist applies maximal positive pressure into the lungs and holds this as the catheter is placed on suction and removed. A postoperative chest radiograph should be obtained if there is any concern about the effectiveness of reestablishing negative pressure within the pleural space.

POSTOPERATIVE ANALGESIA

Before the patient leaves the operating room, 10 ml of 0.25% bupivacaine (Marcaine) solution is injected into the subperichondrial space before the angiocatheter is removed. This measure has helped reduce patient discomfort at the donor site and may therefore help decrease the occurrence of splinting and postoperative atelectasis. Finally, the incision is dressed with Steri-Strips, gauze, and an occlusive dressing.

KEY POINTS

- Autologous tissue is always preferred in secondary rhinoplasty, because the use of alloplastic material increases the rate of infection and/or extrusion.
- The septum is the preferred source in secondary rhinoplasty because it requires no additional incisions, there is no significant donor site morbidity, and its harvest may correct septal deviations and improve the airway.
- The fifth, sixth, and seventh ribs are the ones most often selected for harvest.
- Knowing the position of both bony-cartilaginous junctions is important to ensure that the maximum length of each rib is harvested, thereby optimizing the efficiency of the procedure.
- Particular attention should be directed at reapproximating the perichondrium. The perichondrium should be closed tightly because this layer is fairly rigid and may help to "splint" the wound and reduce postoperative pain.

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The Tripod Concept for Correcting Severely Deformed Nasal Tip Cartilages

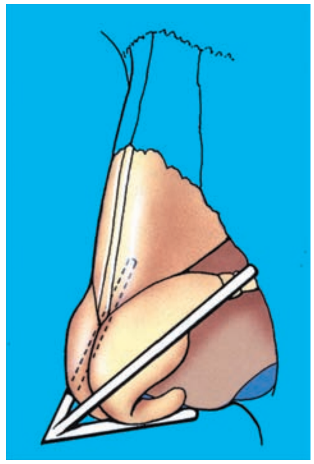
C. Spencer Cochran ▪ Jack P. Gunter

The prime enemies of nasal tip cartilage reconstruction are distortion and displacement of cartilage grafts resulting from scar tissue contraction during the wound-healing phase. It seems logical that the stronger and more stable the reconstructed cartilaginous framework, the better it can withstand the forces of wound contraction. We use this premise in the anatomic correction of severely deformed nasal tip cartilages in secondary rhinoplasty.

The prime enemies of nasal tip cartilage reconstruction are distortion and displacement of cartilage grafts resulting from scar tissue contraction during the wound-healing phase.

BACKGROUND

We have found the tripod concept to be a simple and useful premise for the correction of severely deformed nasal tip cartilages. It has been helpful in the treatment of both primary and secondary nasal tip deformities.



The tripod concept relates nasal tip support and shape to the paired lower lateral cartilage complexes. Each complex consists of a medial crus (which includes the intermediate crus) and a lateral crus. These paired complexes can be visualized as a tripod, with each lateral crus forming a separate lateral (cephalic) leg, and the adjoining medial crura forming the caudal, third leg.[1]

The tripod concept relates nasal tip support and shape to the paired lower lateral cartilage complexes.

INDICATIONS AND CONTRAINDICATIONS

Reestablishment of this tripod is our goal for all nasal tip reconstructions. To be successful, a reconstructed tripod structure must have (1) the strength to support the tip and prevent collapse of the alar sidewalls and (2) the shape to provide the nasal tip with an aesthetically pleasing, natural appearance.

Septal, auricular, and rib cartilage can be used. Each has its own inherent advantages and disadvantages; however, in our hands, autologous rib cartilage has proved to be the cartilage of choice for obtaining predictable and reproducible results.

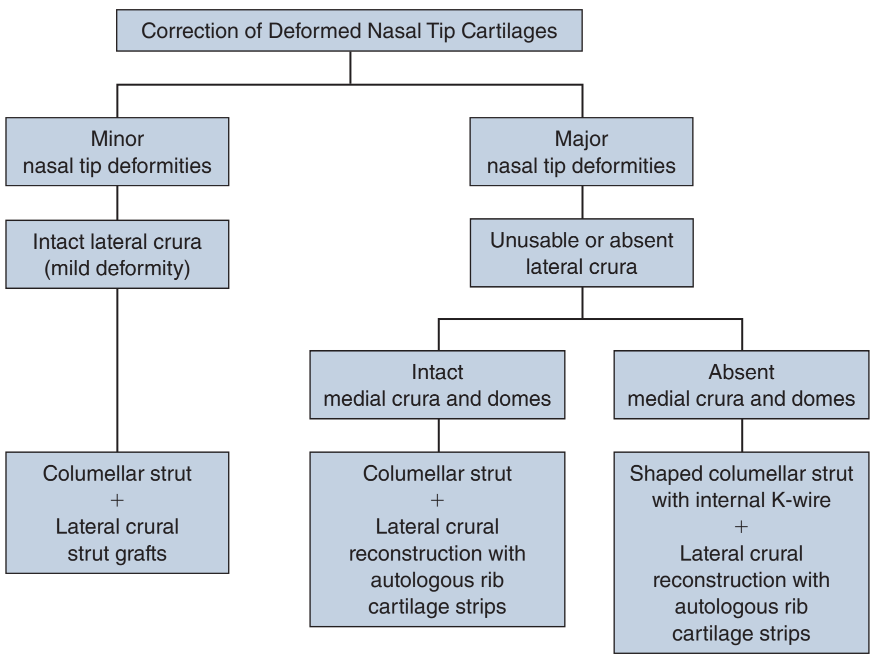
Adherence to the tripod concept has helped us to achieve significant improvement in both functional and aesthetic nasal tip deformities in primary and most secondary rhinoplasty patients. However, secondary rhinoplasty patients with an excessively thin soft tissue envelope and patients in whom additional open procedures will jeopardize the viability of the skin envelope are not good candidates for this technique.

To be successful, a reconstructed tripod structure must have (1) the strength to support the tip and prevent collapse of the alar sidewalls and (2) the shape to provide the nasal tip with an aesthetically pleasing, natural appearance.

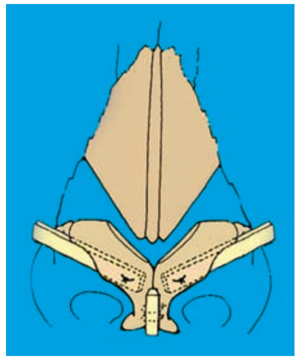
PREOPERATIVE ASSESSMENT AND PLANNING

The method used to rebuild the tripod depends on several factors. The most important of these are (1) the amount of usable cartilage present in the tip and (2) the source of cartilage (septal, auricular, or rib) available for grafting.

OPERATIVE TECHNIQUE

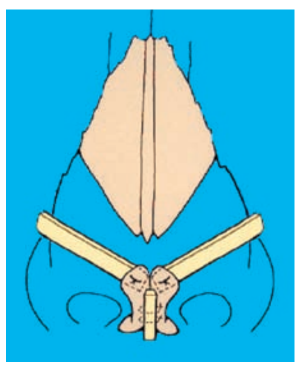


We use a columellar strut in almost all cases of nasal tip reconstruction to stabilize the caudal leg of the tripod and thereby resist displacement by scar tissue contraction or swelling.

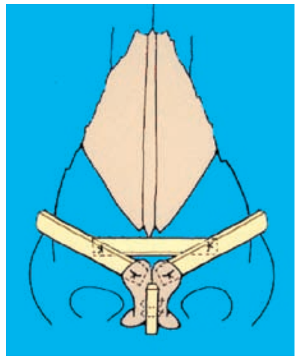


In patients with minor tip deformities and lateral crura that are collapsed or mildly deformed, autologous lateral crural strut grafts placed beneath the existing lateral crura are the treatment of choice to reestablish shape and stability of the lateral legs of the tripod.[2]

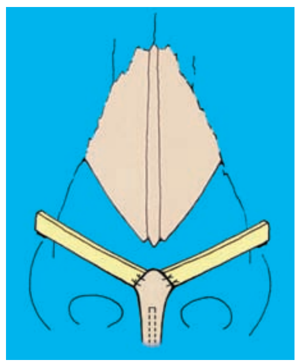
We use a columellar strut in almost all cases of nasal tip reconstruction to stabilize the caudal leg of the tripod and thereby resist displacement by scar tissue contraction or swelling.



When the lateral crura are absent or so deformed that they cannot be used, correction is more challenging. If the lateral crura are not usable but the medial crura and domes are intact, a columellar strut is sutured between the medial crura to strengthen the caudal leg of the tripod. Next, the vestibular skin is undermined off the undersurfaces of the domes. Lateral crural strut grafts of autologous rib cartilage, which are sutured to the undersurface of each dome to replace the missing lateral crura, are placed in an undermined pocket in the alar sidewall inferior to the alar groove. If the pocket is created superior to the alar groove, it can produce a visible bulge at the rim.



If increased width is needed between the lateral legs of the tripod, an alar spreader graft[3] can be sutured between the grafts to displace them laterally.

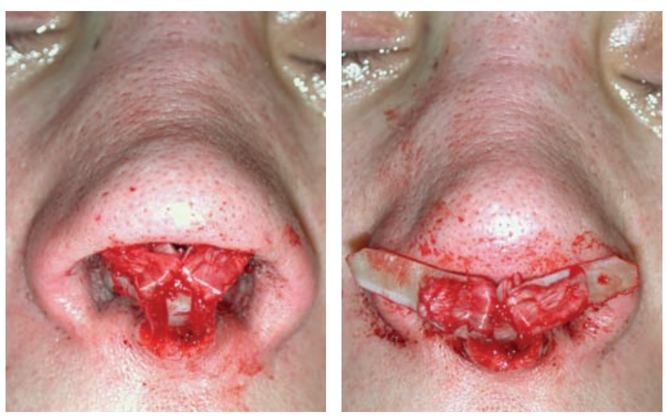


If the medial and lateral crura are absent or unusable, autologous rib cartilage is carved as a shaped columellar strut to act as the caudal leg of the tripod. It is carved to simulate the contour of the caudal margins of the medial crura and medial portion of the domes along the columellar-infratip lobule.

If the medial and lateral crura are absent or unusable, autologous rib cartilage is carved as a shaped columellar strut to act as the caudal leg of the tripod.

The lateral legs of the tripod are reconstructed in a fashion similar to that used when the domes are present. The only difference is that instead of suturing the medial ends of the lateral crural strut grafts to the undersurface of the domes, the surgeon sutures the grafts to the tip of the shaped columellar strut to replace the missing lateral crura. It is preferable and easier to suture the graft strips to the domes, if they are present, than to the tip of the columellar strut. If the domes are absent, a natural-looking tip can be achieved by tapering the anterior tip of the strut to allow the ends of the cartilage strips to blend in with the strut and then carefully suturing them together.

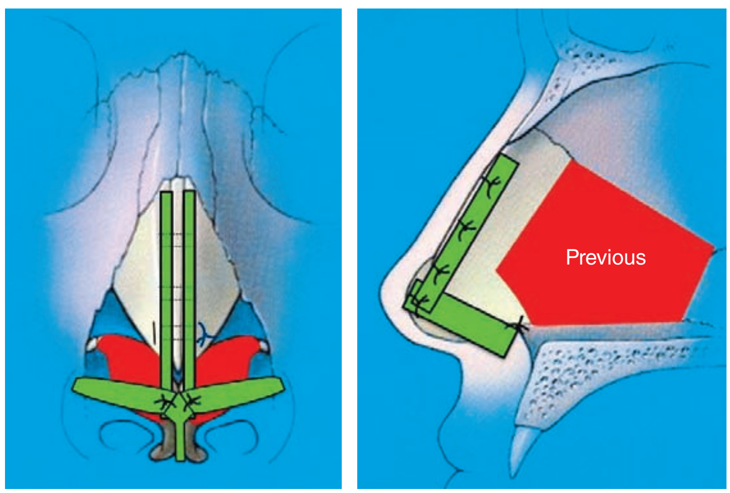
It is preferable and easier to suture lateral crural strut grafts to the domes if they are present than to the tip of the columellar strut.



Alternatively, new domal segments can be created from lower lateral cartilage remnants or from fascia or rib perichondrium. The lateral crural strut grafts are secured under these newly created domes, which helps to create an anatomic tip construct.

CASE ANALYSES

This secondary rhinoplasty patient underwent open secondary rhinoplasty with autologous rib cartilage graft.



Surgical Plan

1. Use an open approach.
2. Harvest autologous rib cartilage for use as graft material.
3. Place extended spreader grafts.
4. Shape and place a columellar strut.
5. Place lateral crural strut grafts.

Her tip was reconstructed with lateral crural replacement grafts and a columellar strut according to the tripod concept.

This 24-year-old woman had open secondary rhinoplasty with autologous rib cartilage graft.

Surgical Plan

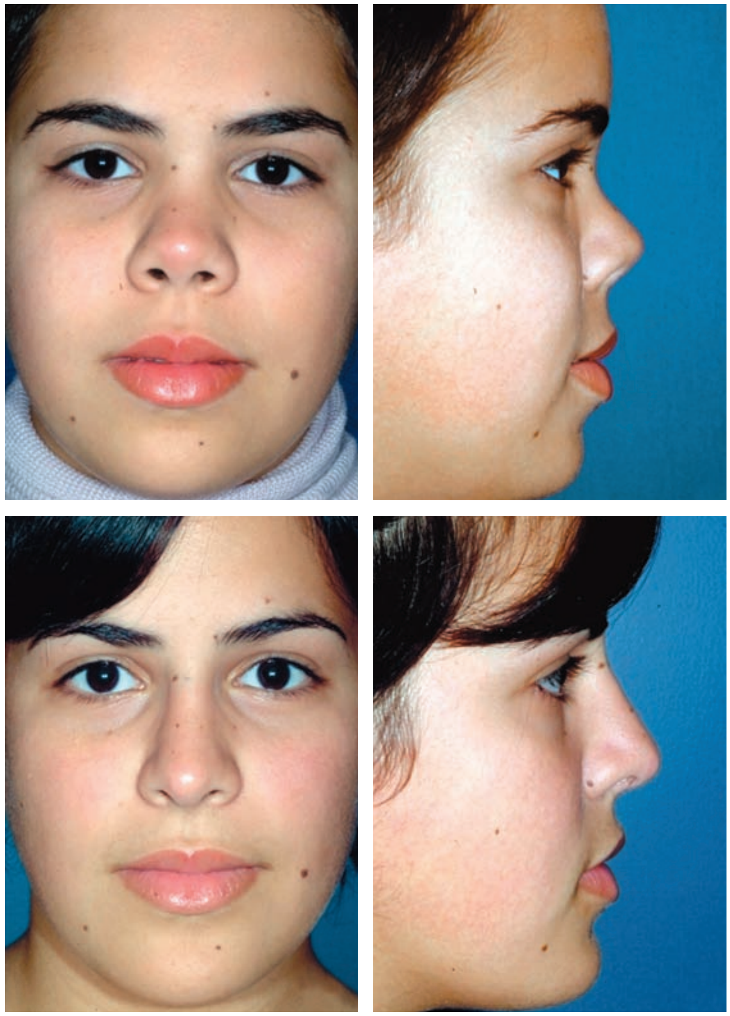
1. Use an open approach.
2. Harvest autologous rib cartilage for use as graft material.
3. Place dorsal spreader grafts.
4. Place a columellar strut.
5. Place lateral crural strut grafts.

The patient is shown 4 months postoperatively. We followed the tripod concept to reconstruct her tip deformity. Missing lateral crura are replaced with lateral crural strut grafts and a columellar strut.

This 14-year-old girl had rhinoplasty at age 6 after a traumatic injury. She had open secondary rhinoplasty with autologous rib cartilage graft.

Surgical Plan

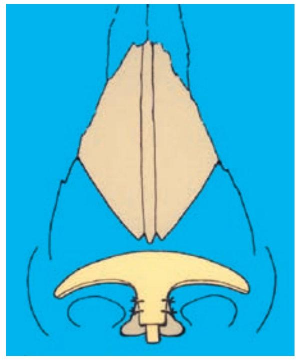
1. Perform an open approach.
2. Harvest autologous rib cartilage for use as graft material.
3. Place dorsal spreader grafts.
4. Place a dorsal onlay graft.
5. Shape and place a columellar strut.
6. Place lateral crural strut grafts.



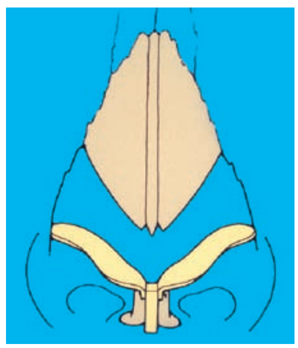
The patient is shown 1 year after secondary rhinoplasty, mentoplasty, and suction lipectomy of her cheeks and neck. Lateral crural strut grafts were sutured to a shaped columellar strut. Rib cartilage was used to create a dorsal onlay graft.

ALTERNATIVE TECHNIQUES

We prefer the previously described methods for reconstructing severely deformed lower lateral cartilage complexes. However, the following techniques are available if rib cartilage cannot be used. We have used them with limited success. Our results with autologous rib cartilage are more consistent and reproducible.



An anchor graft of auricular cartilage, as described by Juri and Juri,[4] can be fashioned to reshape the tip and alar rims.



Anatomically shaped lateral crura carved from auricular cartilage grafts can be sutured to the sides at the tip of a columellar strut to replace missing lateral crura.

KEY POINTS

- The prime enemies of nasal tip cartilage reconstruction are distortion and displacement of cartilage grafts secondary to scar tissue contraction during the wound-healing phase.
- The tripod concept relates nasal tip support and shape to the paired lower lateral cartilage complexes.
- To be successful, a reconstructed tripod structure must have (1) the strength to support the tip and prevent collapse of the alar sidewalls and (2) the shape to provide the nasal tip with an aesthetically pleasing, natural appearance.
- We use a columellar strut in almost all cases of nasal tip reconstruction to stabilize the caudal leg and thereby resist displacement by scar tissue contraction or swelling.

- If the medial and lateral crura are absent or unusable, autologous rib cartilage is carved as a shaped columellar strut to act as the caudal leg of the tripod.
- It is preferable and easier to suture the lateral crural strut grafts to the domes if they are present than to the tip of the columellar strut.

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Structural Grafting in Secondary Rhinoplasty

Dean M. Toriumi ▪ Jaimie DeRosa ▪ Deborah Watson

Most plastic surgeons consider secondary rhinoplasty to be one of the most challenging procedures they perform. Suboptimal results from a primary rhinoplasty can be caused by many factors that have adversely changed the nasal structure and/or function. These errors are usually attributed to poor preoperative diagnosis and planning, incorrect selection of surgical technique, and/or poor execution of a surgical maneuver. The results from a rhinoplasty are not static—the nose continues to heal and change over the years. The resultant problems may not become evident until 10 to 15 years after surgery, because scar contracture and healing alter the overall structure and function of the nose.

Surgeons can take advantage of a secondary rhinoplasty as an opportunity to better understand what could have been done to prevent suboptimal outcomes. Aggressive resection and weakening of the nasal skeleton, including the major support structures of the nose, without maintaining or rebuilding of the nasal framework can lead to deformities. At the completion of surgery, surgeons should have a good idea of how the nose will heal in the following months, years, and decades. Structural grafting can help to reduce the uncertainty of changes over time and allow correction of significant complications, both aesthetic and functional, resulting from the primary surgery.

Careful assessment of the nose is essential before a secondary rhinoplasty, because the procedure requires working with inherent characteristics and limitations.[1] Damage to the skin–soft tissue envelope can appear as cutaneous telangiectasias, blue or purple discoloration of the skin in cold temperatures, or visible irregularities. The inherent character of the skin–soft tissue envelope is also important; thick, sebaceous skin can camouflage grafts but redrapes poorly

over an overly resected nasal framework. Conversely, thin skin will reveal minor irregularities in the underlying structural framework but more easily redrapes over a smaller framework. The nasal framework may be significantly compromised or missing after previous surgery. For example, a foreshortened nose with a tight skin–soft tissue envelope may not tolerate the desired degree of lengthening. Nevertheless, structural grafting techniques provide the means to obtain a desirable result.

Secondary rhinoplasty requires assessment of all changes in nasal structure and function that are a result of prior surgery.

The goal of reoperation of a previously operated nose is reconstruction of the nasal framework to produce an aesthetic and functional improvement. Reconstruction of structural and/or functional deformities should achieve a more normal and balanced nasal shape, reestablish nasal support, restore tip projection, and maximize the airway. A variety of structural grafts may be required to achieve these goals.

Preservation of the structural nasal framework is essential for successful long-term rhinoplasty results. Intraoperative weakening of structural components requires reconstitution at the time of surgery.

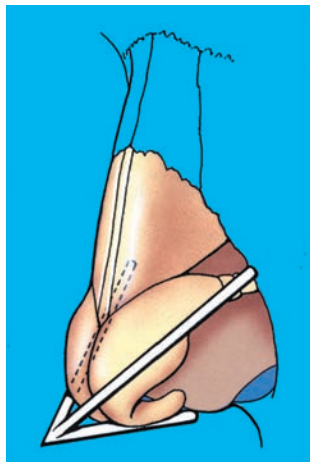
A closed approach can be used for precise pocket grafting in revision rhinoplasty to fill defects and provide modest support. However, open rhinoplasty provides wide exposure of the previously operated field, allowing improved analysis of the cartilaginous and bony architecture and direct visualization of the areas in need of correction. Moreover, previously placed grafts can be removed under direct vision. Near-complete reconstruction of the nasal structures can be accomplished through an open rhinoplasty.

An open rhinoplasty approach in revision surgery is recommended, because it allows full examination of the nasal structure and deficiencies to accurately determine and execute necessary changes under direct vision.

A layer of scar tissue often develops beneath the skin–soft tissue envelope, with obliteration of normal tissue planes. Scar tissue can be extensive if reduction of the nasal structural framework was aggressive and out of proportion to the size and/or thickness of the overlying skin–soft tissue envelope. The dead space cre-

ated fills with scar tissue. Despite the thickness of this tissue, the skin–soft tissue envelope is dissected and elevated in the supraperichondrial/periosteal plane with extreme care to preserve the vascular integrity of the skin–soft tissue envelope. If the planes are no longer present, dissection should be immediately superficial to the underlying cartilage and bone. With an open approach, structural grafts can be fixated with precise suture placement.

SECONDARY TIP DEFORMITIES



The lower third of the nose has been compared to a tripodlike support structure that comprises the conjoined medial crura and both lateral crura (see Chapter 40). The medial crura together form one leg of the tripod, and the lateral crura make up the other two legs. The middle crura act as a transition between the different planes between the lateral and medial crura. The middle crura also contribute to the double break and infratip lobule seen in unoperated noses. The tripod should be maintained in rhinoplasty to provide tip support and normal tip shape. In revision rhinoplasty, grafting is often performed to restore the tripod structure, which should help to resist malpositioning over time.

Major tip support mechanisms need to be understood and respected in both primary and secondary rhinoplasty. Components of major tip support include the length and strength of the lower lateral cartilages, the attachment of the cephalic margin of the lateral crura to the caudal margin of the upper lateral cartilages, and the ligamentous attachments between the conjoined medial crura and the caudal septum. Interruption of one or more of these support mechanisms necessitates reinforcement of tip support.

The reestablishment of tip projection is often desired during secondary rhinoplasty. Techniques used in previous rhinoplasty procedures may have weakened tip support with resultant loss of tip projection, columellar retraction, asymmetry, cartilaginous buckling/bossae, lateral alar flaring, and/or cephalic alar

retraction. The dome region is at risk for unpredictable healing, especially if the anterior septal angle is resected in conjunction with domal manipulation. Complete transfixion incisions can decrease tip projection because of the transection of ligamentous attachments between the caudal septum and the medial crural footplates. Aggressive trimming of the caudal septum can compromise tip support and projection. Overresection of the cephalic region of the lateral crus can weaken the arch of the lower lateral cartilage and cause bossae formation.

FUNCTIONAL NASAL DEFICITS

Nasal obstruction secondary to nasal valve collapse can usually be attributed to lateral nasal wall weakness. Negative airway pressure produced by nasal airflow can collapse a poorly supported lateral nasal wall into the airway, with resultant obstruction.

Functional nasal deficits after rhinoplasty include internal and external valve collapse. Internal nasal valve collapse can be corrected by the placement of spreader grafts, lateral crural strut grafts and/or alar batten grafts. Lateral crural strut grafts increase lateral wall support. Alar batten grafts and alar contour grafts help to correct external nasal valve collapse.

Internal Nasal Valve Collapse

The internal nasal valve is the anatomic area bounded by the caudal margin of the upper lateral cartilage, the nasal septum, the floor of the nose, and at times an enlarged inferior turbinate. The internal angle between the septum and upper lateral cartilage should be at least 15 degrees. Internal nasal valve collapse is

common after reductive rhinoplasty. Collapse of the internal valve can be seen with medial collapse of the caudal margin of the upper lateral cartilage during nasal inspiration (creating negative pressure). Supraalar pinching warrants assessment for internal valve collapse.

Correction of internal nasal valve weakness usually involves the addition of structural support to the nasal sidewalls and/or repositioning the upper lateral cartilages. The most common structural graft used to support the lateral nasal side wall is an alar batten graft.[2-5] To lateralize the upper lateral cartilage, and thereby reduce middle vault collapse, spreader grafts can be positioned between the upper lateral cartilages and the septum. We frequently use lateral crural strut grafts to add support to the lateral wall of the nose and place spreader grafts to reconstruct the middle nasal vault.[2,6,7] Smaller flat alar batten grafts can then be applied to provide additional support to the lateral wall if the lateral crura are repositioned caudally.

Sometimes internal valve collapse is the result of contracted scars in the region of the nasal valve, excessive vestibular skin resection, and/or strictures that form after poor reapproximation of incisions used for a closed approach. The most common methods for correcting such problems include excision of the scar followed by reconstruction with composite grafts (composed of anterior skin and cartilage from the concha cymba of the auricle), local mucosal flaps, or a Z-plasty scar revision. We find that the addition of support and lining after excision of the scarred or contracted mucosal tissues provides the best improvement in nasal function.

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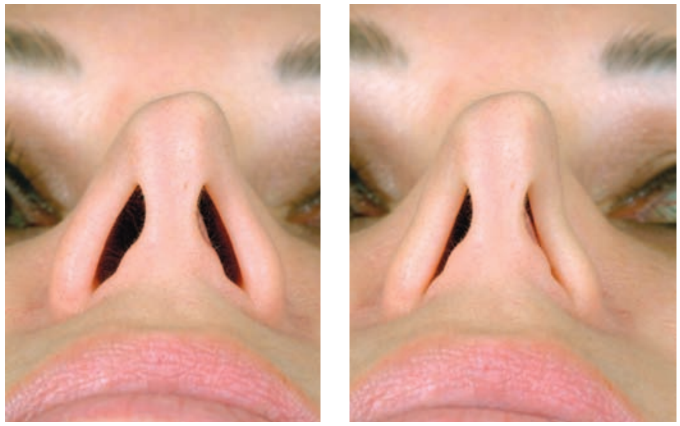
External Nasal Valve Collapse

An external nasal valve collapse involves collapse of the nostril margin or alar lobule during mild to moderate nasal inspiration. It is typically seen in conjunction with narrow nostrils and an overprojected nasal tip. Several methods can be used to correct this problem, including deprojection of the nasal tip, which creates a more oval-shaped nostril and a triangular nasal base, and placement of alar rim grafts into the alar lobule for additional structural support. Lateral crural strut grafts will also provide additional support to an external nasal valve.



This patient presented with external nasal valve collapse. Narrow slitlike nostrils were noted *(left)*. Moderate inspiration through the nose revealed collapse of the nostrils at the external nasal valve *(right)*.

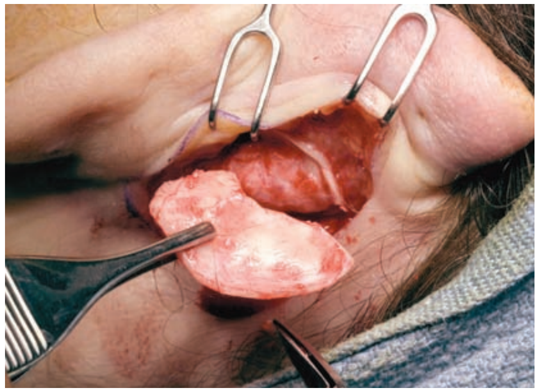
AUTOLOGOUS GRAFT MATERIAL

Autologous grafts are the preferred material for both primary and secondary rhinoplasty. The principal material for such grafts is cartilage. Over time, we have found that nonautologous grafts or implants yield an unacceptable risk for inflammation, infection, extrusion, pain, and excessive scar tissue. Therefore autologous material is recommended for all grafting needs in rhinoplasty.

We have found that nonautologous grafts or implants yield an unacceptable risk for inflammation, infection, extrusion, pain, and excessive scar tissue.

The three main sources of cartilage for rhinoplasty are the nasal septum, auricle, and rib. The septum is the most commonly used source for structural grafting. It is easily accessible, because it is within the surgical field and often is partially removed to improve the nasal airway. A large portion of septal cartilage can be harvested without loss of septal support as long as an L-shaped caudal and dorsal septal strut of at least 15 mm remains intact. When septal cartilage is unavailable or inadequate, alternative sources are harvested.

Autologous cartilage is the principal source of graft material for structural reconstruction in rhinoplasty. Nasal septal, auricular conchal, and rib cartilage are most commonly harvested.



Auricular cartilage is relatively easy to harvest. The cymba and cavum concha can be removed, yielding approximately 35 to 40 mm of cartilage. A posterior approach for harvesting is preferred, because the scar created is located behind the ear in the postauricular crease. The inherent properties of auricular cartilage such as its natural curvature must be considered. Donor site morbidity is minor, and most ears heal with minimal to no shape alteration or scarring.

In patients with insufficient or no septal and/or auricular cartilage, costal cartilage can be used. In the past, donor site morbidity and unreliability of the graft were cited as reasons to avoid the use of costal cartilage. However, technical refinements have significantly decreased donor site morbidity. Moreover, surgeons who can properly sculpt and position costal cartilage grafts can reliably use this cartilage for rhinoplasty.

Grafts should be camouflaged as needed in both primary and secondary rhinoplasty. Crushed cartilage or perichondrium can be used for this purpose. Both can help to soften the underlying graft and hide irregularities. Two of the three major sources of cartilage, the auricle and the rib, are good sources of perichondrium. Fascia can be used for similar applications; however, a separate harvest site necessitates an additional incision and potential morbidity.

This costal cartilage was harvested for graft material. The strip of perichondrium on the anterior surface of the cartilage was removed and used for graft camouflage.

In the past, both calvarial and iliac crest bone grafting were discussed as additional sources for structural grafting in rhinoplasty. However, the use of costal cartilage has virtually obviated the need for these graft sources. Moreover, cartilage grafts appear to provide a more natural appearance and feel to the operated nose.

STRUCTURAL GRAFTING IN SECONDARY RHINOPLASTY

The philosophical approach to secondary rhinoplasty is similar to that in a primary case, except that the former requires more of a reconstructive component. The objectives should include improvement of nasal shape and airway and establishment of a stable foundation that can withstand the forces of scar contracture and healing over the long term. When a prior surgery has been performed, the components of the nose can be radically altered or damaged, including the skin–soft tissue envelope and cartilaginous supporting structures. These factors need to be considered during the revision procedure, and may limit the techniques and material available to achieve the desired results. For example, a severely foreshortened nose with a tight skin–soft tissue envelope may not tolerate the ideal degree of lengthening and counterrotation that might have been more easily achieved with structural grafts in a primary rhinoplasty. Nevertheless, the following structural grafts can be helpful in secondary rhinoplasty.

Tip Projection

The ability to control tip projection is essential to a successful rhinoplasty. When a surgeon sets the tip projection in a stable fashion, the effects of healing and scar contraction are lessened, even if major tip support mechanisms were breached intraoperatively. The final position of the nasal tip over time is determined by the strength, length, and support of the medial crura; support from the caudal septum, anterior nasal spine, and premaxilla; the degree of depressor septi nasi muscle activity on the nasal base; and the degree of fibrous tissue reattachment of the columella to the caudal septum.

The surgeon can then create or preserve an adequate nasal tip–supratip relationship. With an increase in tip projection, a higher dorsum can be maintained, helping to create an appearance of a narrower, better proportioned nose. This technique is invaluable in patients with thick skin, in whom redraping of the skin over an overresected nasal skeleton results in inferior results, including a soft tissue pollybeak and a wider-appearing nose. To set tip projection, the nasal base is stabilized, and then the nasal tip lobule is appropriately contoured.

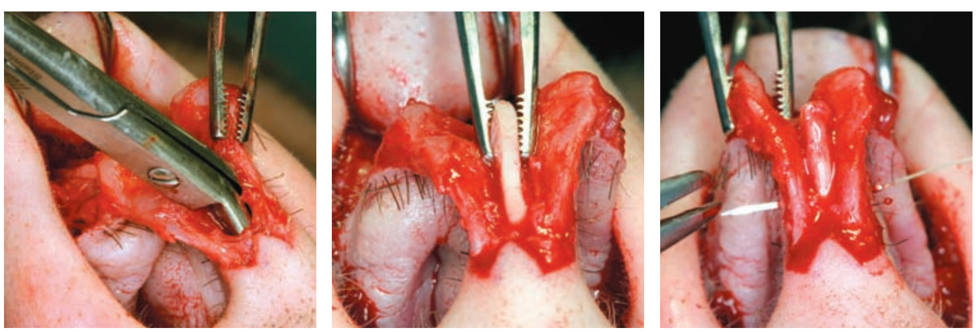
Structural grafts that allow surgeons to set tip projection by stabilization of the nasal base include a columellar strut graft, a caudal septal extension graft, and

an extended columellar strut graft. These can be created from either septal or costal cartilage, because both have sufficient structural support to provide long-term stability. In contrast, auricular cartilage is less effective for stabilizing the nasal base; instead, its softer composition is better used for other structural grafts such as alar rim grafts, alar batten grafts, lateral crural grafts, and spreader grafts. Particular suture techniques are helpful to stabilize the base, such as setting the medial crura back on the caudal septum. We will focus, however, on the graft techniques.

Tip projection can be established with a columellar strut graft, caudal septal extension graft, or an extended columellar strut graft. The decision to use a specific graft is determined by the intraoperative deficits and goals of the surgery. Stabilization of the nasal base is critical to minimize postoperative loss of tip projection.

Columellar Strut Graft

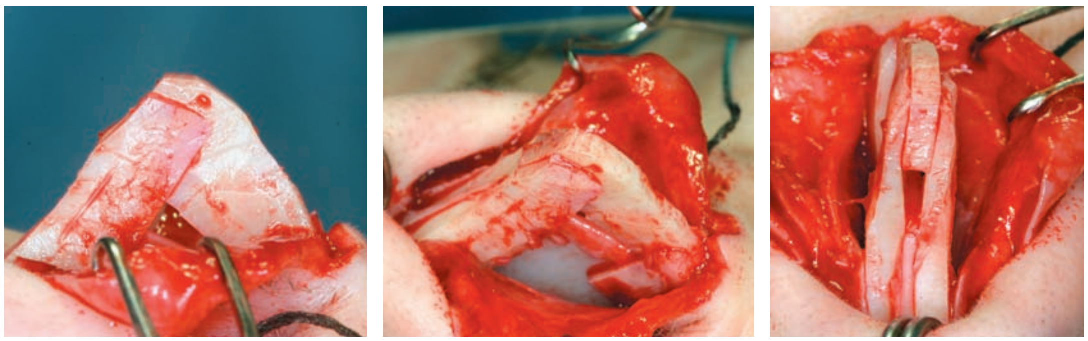
A columellar strut graft is useful if the alar-columellar relationship is appropriate and the tip is already well supported. It can stabilize the nasal base and strengthen weak medial and middle crura. A columellar strut improves tip support, usually with no effect on tip projection. It is a rectangular piece of cartilage that is set in a pocket between the medial crura and the middle crura. It does not sit on the anterior nasal spine, but instead it rests on soft tissue above the spine. Typically it measures 5 to 12 mm long, 3 to 6 mm wide, and 1 to 3 mm thick.



The tissue between the medial crura is sharply dissected *(left)*. The rectangular columellar strut graft is placed between the medial crura, preserving a bed of soft tissue between it and the anterior nasal spine *(center)*. If the strut is placed too close to the nasal spine without fixation, the patient may note a clicking sensation when smiling. The graft is fixed to the medial crura by a 5-0 chromic gut suture. It then is stabilized with a 5-0 clear nylon suture *(right)*.

Caudal Septal Extension Graft

A caudal septal extension graft can be applied to achieve a variety of goals, including rotation, counterrotation, deprojection, and/or projection of the nasal tip. The graft is a rectangular piece of cartilage that extends off the existing caudal septum (or overlaps the septum slightly) and is sutured between the medial crura. In most cases the graft is placed end to end to prevent blocking of the nasal airway. The specific placement of the graft and sutures can result in stabilization of the nasal base and setting of tip projection with a proper alar-columellar relationship.



The graft is extended caudal to the existing caudal septum in an end-to-end orientation *(left)*. In this case the caudal extension graft is stabilized with bilateral extended spreader grafts. In addition to the spreader grafts, two smaller, thinner splinting grafts are placed to further stabilize the caudal septal extension graft *(center)*. The view from above shows bilateral splinting extended spreader grafts *(right)*. If longer spreader grafts or thin cartilage splinting grafts are not available, a 0.25 mm PDS plate can be used to stabilize the end-to-end caudal septal extension graft. Small holes can be made in the PDS plate to allow vascular ingrowth and fibrous tissue ingrowth.

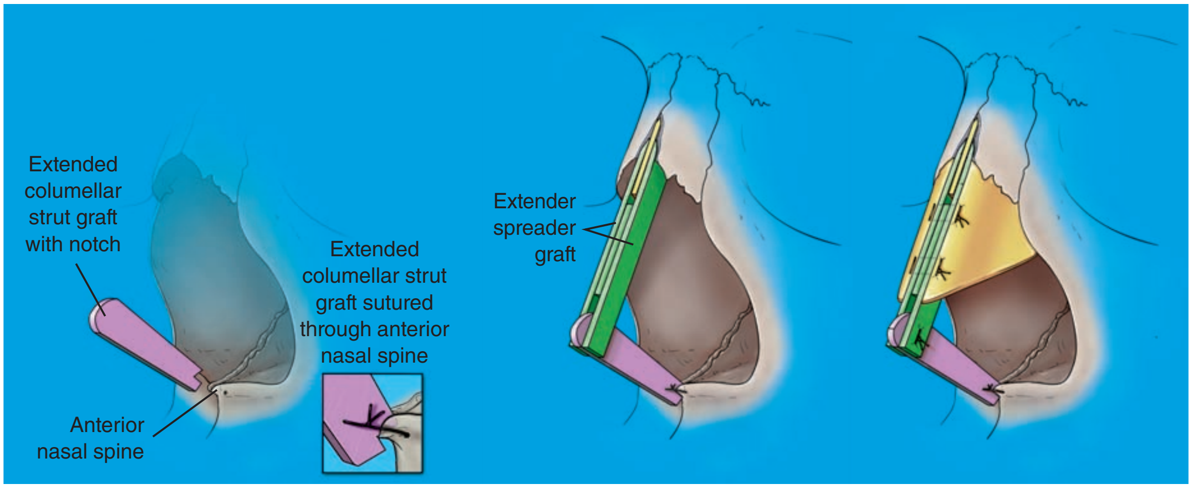
Extended Columellar Strut Graft

An extended columellar strut graft is used in patients who have major deficiency in tip projection and support, excessively thick skin, or extensive scar tissue. Many of these patients have a dependent nasal tip and an excessively acute nasolabial angle because of previous excision of the caudal septum or congenital deformity that includes a deficiency in the premaxilla.

Examples include patients with Binder's syndrome or cleft lip–nasal deformity. They require greater augmentation than can be provided with a traditional columellar strut graft.

These grafts are usually crafted from costal cartilage and need to be straight. Careful observation is required because of the tendency for the cartilage to bend.

If the costal cartilage has a tendency to bend, splinting grafts of opposing curvature can be sutured to the graft to ensure that it is straight. Extended columellar strut grafts can be notched to sit firmly in a notch in the anterior nasal spine.



The graft is then sutured through the periosteum of the anterior nasal spine or through a hole created through the anterior nasal spine (using a 16-gauge needle) using at least two 4-0 PDS sutures. The graft typically measures 25 to 50 mm long, 5 to 10 mm wide, and 3 to 5 mm thick. It spans the distance between the desired tip-defining point and the premaxilla. After the graft is positioned, the medial crura are advanced on the strut to increase both tip projection and the nasolabial angle.

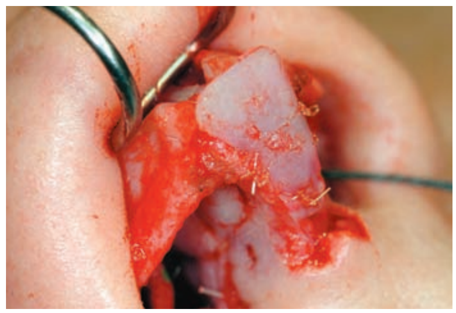
Several points should be considered when planning an extended columellar strut graft. First, the soft tissue between the medial crura and over the anterior nasal spine must be adequately dissected to allow the graft to properly sit on the premaxilla and achieve the desired tip projection. Also, closure of the skin over the graft can be difficult when the tip has been projected substantially. Therefore the ability to close the skin should be tested after the graft is set in place. Patients should be informed that the nose will be very stiff and unyielding postoperatively, the upper lip may be stiffer, and a crease can be present in the upper lip when they smile.

Stabilization of the nasal base with a caudal septal extension graft or an extended columellar strut graft is particularly important when the lateral crura are replaced or repositioned. In these cases a stable nasal base is necessary to prevent twisting or torquing of the nasal tip cartilages. A conventional columellar strut graft may not provide enough stability to prevent twisting or torquing, which can cause asymmetrical nostrils, deviation of the tip, or excessive tip rotation.

Nasal Tip Lobule

Once the nasal base and projection are set, additional modifications to the tip can be made at the nasal lobule. Not all refinements are achieved through structural grafting. For example, we frequently use bilateral dome-binding sutures to narrow the domes and set tip width. In secondary rhinoplasty, however, structural grafting may be necessary to achieve the proper tip projection and definition.

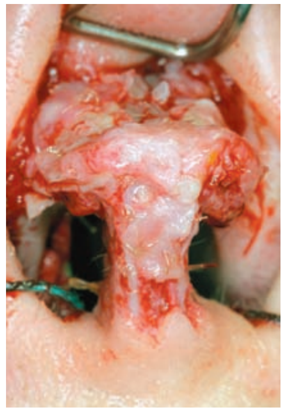
Tip Graft



A tip graft can be helpful to increase tip projection and/or improve tip contour. It is sutured to the caudal margin of the medial and middle crura using 6-0 Monocryl sutures. Most commonly the graft is carved into a shieldlike shape and is thicker at the anterior leading edge and thinner at the posteroinferior margin. It usually measures 8 to 15 mm long, 8 to 12 mm wide, and 1 to 3 mm thick.

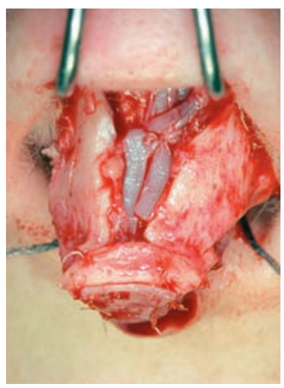
A variety of structural grafts can help to achieve a natural-appearing nasal tip lobule. For example, a tip graft can help to set tip projection, hide tip asymmetries, reestablish nasal support mechanisms, and improve the stability of the medial crural–columellar strut complex.

To reduce the incidence of graft visibility, several modifications are needed. First, the graft's edges are beveled to create a smooth transition with surrounding structures. Softer cartilage is preferred such as that from the auricle or septum (in contrast to the stiffer costal cartilage), because it allows cephalic rotation to create a double break. If costal cartilage is used, an intrinsically curved piece can be carved thin to allow proper shaping of the infratip lobule.



Finally, perichondrium or crushed cartilage can be sutured around the superior edge of the graft. These modifications provide camouflage to prevent visualization of the tip graft. Perichondrium can be sutured over the tip graft for additional camouflage. Tip grafts should not be used in patients with thin skin.

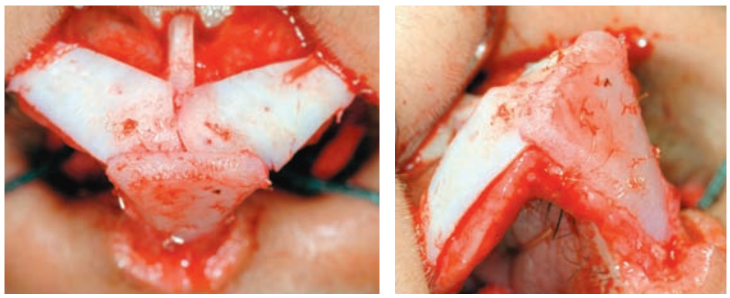
Cap Graft/Buttress Graft



A cap or buttress graft sits behind the leading edge of a tip graft. When sutured in place, it helps to better stabilize the tip graft and provide a smoother transition from the lateral aspect of the tip graft to the preexisting domes. A cap graft can be placed to provide additional support at the leading edge of a tip graft that demonstrates excessive cephalic rotation.

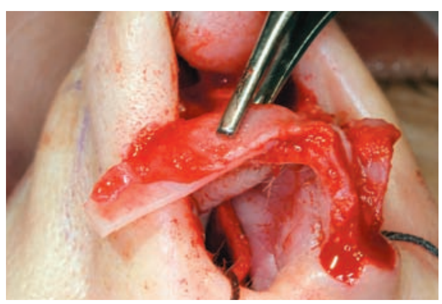
Lateral Crural Graft

When a tip graft projects 3 mm or more above the surrounding cartilage, additional grafting is recommended to reduce the risk of graft visibility. The grafts are sutured to the lateral margin of the tip graft and fixed to the lateral crura. They help to camouflage tip grafts.

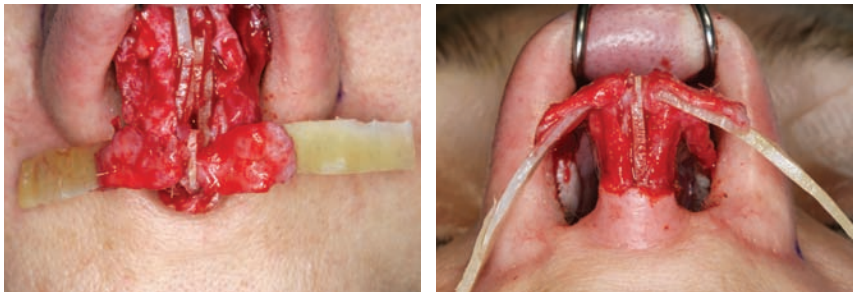


Lateral crural grafts are placed at approximately a 45 degree angle to the lateral margin of the tip graft. They provide a smooth transition between the tip graft and the lateral crura.

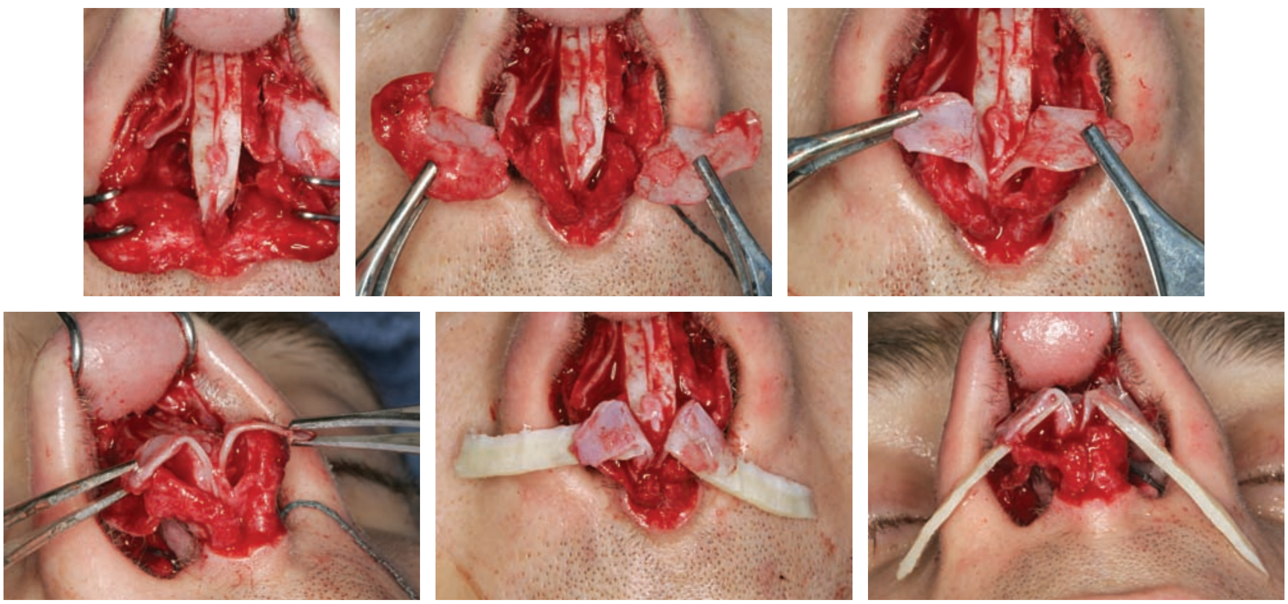
Lateral Crural Strut Graft



In contrast to a lateral crural graft, a lateral crural strut graft is placed between the undersurface of the lateral crura and the vestibular skin. Rectangular in shape, it can provide additional support for weak lateral crural cartilages and help to flatten bulbous lateral crura. In addition, these grafts help to re-create the natural-appearing triangular shape of the nasal base and support the lateral wall of the nose. In this patient, the lateral crus was dissected from the underlying vestibular skin, and the lateral crural strut graft was sutured to the undersurface of the lateral crus.



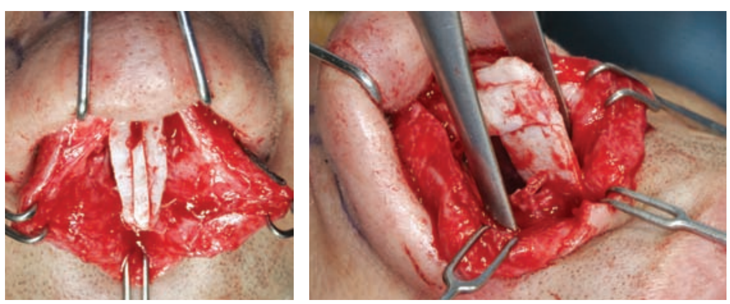
In most secondary cases, lateral crural strut grafts are used to support previously overresected lateral crura.[7] In such cases the lateral crural strut grafts act to reinforce existing weakened or overresected lateral crura. In most secondary rhinoplasty patients, the remnants of the lateral crura are adequate so that grafts can be sutured to them. However, the lateral crura or the domes can be deformed to the extent that they are not salvageable. In these cases, the lateral crura can be reconstructed using remnant lateral crura, soft fibrous cartilage, or scar tissue.



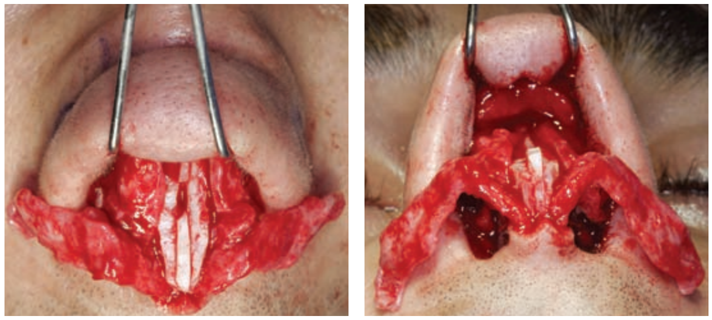
Once a stable foundation is established in the form of a caudal septal extension graft or extended columellar strut graft, the remnant cartilage or soft tissue can be sutured to the graft. The cartilage is fixed to the extension graft with 5-0 PDS sutures and angled off the midline by about 45 degrees. Lateral crural strut grafts can be sutured to the new dome structures using 5-0 PDS. Adson forceps are used

to pinch the cartilage where the new domes should be located to allow bending at that point. Dome sutures of 5-0 PDS can be used to create a favorable dome width. If necessary, a horizontally oriented onlay tip graft is placed over the new domes to provide camouflage and definition.

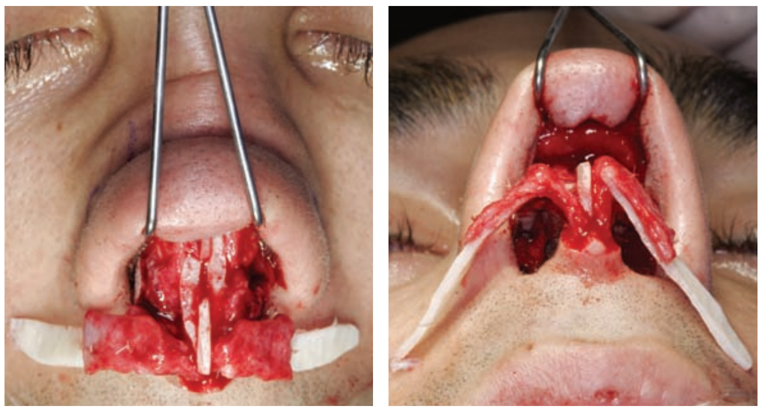
Lateral crural strut grafts are the most effective means for correcting alar retraction. The use of composite skin cartilage grafts taken from the ear provide lining with the attached structure for smaller areas of notching. More significant alar retraction requires more substantial support to correct the deformity.



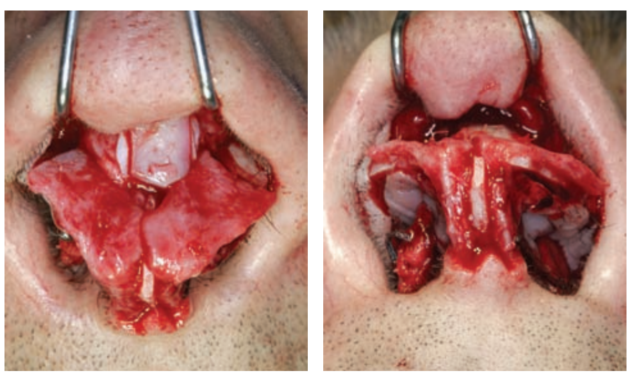
In these cases a stable base is created by a caudal septal extension graft or an extended columellar strut graft.



Then the lateral crura are dissected from the underlying vestibular skin.



Lateral crural strut grafts measuring 25 mm or more are sutured to the undersurface of the lateral crura.



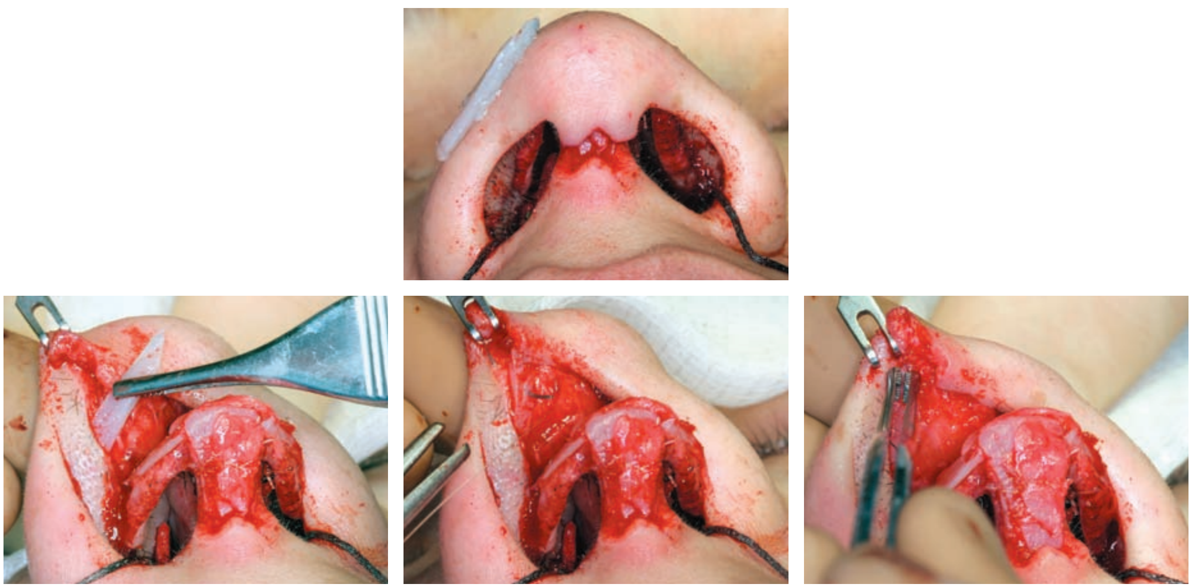
The lateral crura with lateral crural strut grafts are then placed into caudally positioned pockets. If one ala is more retracted, then the pocket is made more caudal on that side. Placement of the pockets is critical for symmetry. Once in place, the positions of the alar margins are checked for symmetry. If vestibular mucosa is inadequate to close the infracartilaginous incision, a composite skin-cartilage graft is harvested from the cymba concha to fill the defect. Lateral wall splints are placed to hold the grafts in place.

This method for correcting alar retraction is very effective and provides good long-term outcomes.

Alar retraction can be corrected with lateral crural strut grafts, repositioning of the lateral crura caudally, and use of a composite auricular graft if tension is excessive in the closure of the marginal incision.

Alar Contour Graft

Alar contour grafts are invaluable in the creation of proper tip shadowing and triangularity of the nasal base. These are especially useful for improving alar rim support in patients with insufficient support along the alar margin, as seen in patients with external valve collapse.[8] The grafts are composed of narrow pieces of soft cartilage measuring approximately 5 to 8 mm long, 2 to 3 mm wide, and 1 to 2 mm thick. They are inserted into pockets created at the caudal margin of the infracartilaginous incision. The medial aspect of the graft is sutured to the soft tissue or occasionally to the lateral margin of a tip graft. To reduce graft visibility, soft cartilage is preferable, and the medial margin is gently crushed once it is in position.



An alar contour graft is shown on the nasal skin over the site of placement. It is placed in a pocket located at the caudal edge of the infracartilaginous incision, and the medial edge of the alar contour graft is sutured to surrounding soft tissues using 6-0 Monocryl. The medial margin of the graft is gently crushed to prevent graft visibility.

Middle Vault Reconstruction

The middle vault comprises the septum and upper lateral cartilages. Its stability has a direct effect on the function of the internal nasal valve. Middle vault collapse can be seen in nonoperated noses, but it is much more common in patients who have had rhinoplasty in which stabilization of this nasal region was insufficient. Middle vault collapse can be corrected (or prevented) by placement of spreader grafts and, when necessary, alar batten grafts.[9]

Spreader Grafts

Spreader grafts are invaluable in the correction of middle vault insufficiency. The graft is a rectangular piece of cartilage measuring 6 to 25 mm long, 3 to 5 mm high, and 2 to 4 mm thick. It is precisely placed in a subperichondrial tunnel that is created between the upper lateral cartilage and the septum and sutured in place. The cephalic edge of a spreader graft should be placed just under the caudal edge of the nasal bones and beveled to prevent lateralization of the nasal bone. Improper positioning of the grafts too high under the nasal bones can cause undesired widening in the upper third of the nose.

A number of technical points should be considered when reconstruction with a spreader graft is planned. Thicker spreader grafts (2 to 4 mm) may be needed on one or both sides of the septum to improve the width of the middle vault. The grafts should be slightly thicker at the caudal edge of the nasal bones and narrow toward the anterior septal angle. Once spreader grafts are sutured into position, the upper lateral cartilages are then sutured to both the grafts and septum. Trimming of the dorsal aspect of spreader grafts may be required to create a smooth dorsal profile.

In this patient, the middle vault support was reconstructed with rectangular spreader grafts placed on both sides of the dorsal septum. Once in position, the upper lateral cartilages were sutured back to both the septum and the spreader grafts. Bilateral costal cartilage spreader grafts were used to reconstruct the middle nasal vault.

Spreader grafts can be used in this fashion to correct severe collapse of the middle nasal vault. This patient had a previous reductive rhinoplasty that resulted in severe middle nasal vault collapse with an inverted-V deformity. Her nose is foreshortened, the result of previous overresection of the caudal septum. Bilateral extended spreader grafts and an extended columellar strut graft were placed. A shield tip graft with lateral crural grafts was also applied.

Alar Batten Graft

Alar batten grafts are helpful to correct supraalar pinching and/or lateral nasal wall weakness. They can provide structural support to the lateral wall to correct the collapse. These grafts are placed in pockets along the lateral nasal wall at the site of maximum supraalar pinching, with the lateral edge of the graft resting near the piriform aperture. The site of maximum lateral wall collapse often corresponds to the caudal margin of the upper lateral cartilage and the cephalic margin of the lateral crus.

The graft should measure approximately 10 to 15 mm long and 4 to 8 mm wide, with minimal thickness (1 to 2 mm). Inherent cartilage curvature can be an advantage. The convex surface of the graft should be oriented laterally to counteract the medialization forces of scar contracture and nasal inspiration. Triangular plastic splints placed in the nasal vestibule postoperatively help to hold the grafts in their lateral, supporting position.

The point of maximum supraalar pinching is marked before alar batten grafts are placed and positioned. Typically grafts are placed bilaterally. If greater pinching or weakness is noted on one side, a larger graft can be applied.

Composite Graft

Composite grafts are very important in secondary rhinoplasty, because they can provide internal lining with attached cartilaginous structural support. They are typically harvested from the cymba concha of the ear. If a large graft is needed, they can be harvested from the entire concha.

In this patient, the graft was taken from the anterior surface of the auricle, just medial and inferior to the anterolateral surface of the auricle. It was harvested and handled carefully to prevent damage.

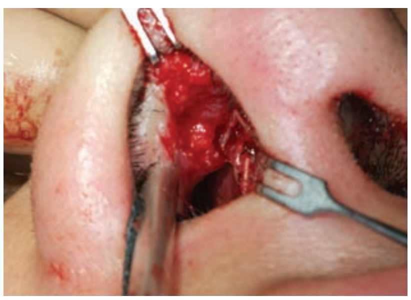
The donor site can often be closed primarily. If a graft is large, the donor site is closed using a full-thickness skin graft from the posterior auricular region.

A composite graft is shown ready for use. It is inserted into a pocket caudal to the lateral crus at the infracartilaginous incision and sutured into place.

In most patients with alar retraction, other grafts such as lateral crural grafts and alar contour grafts may be needed in addition to composite grafts.[10] This woman presented with severe retraction of her left alar margin. Her nose was short and overrotated.

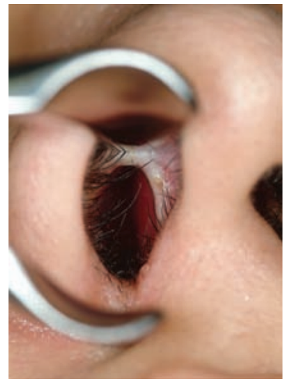
Treatment required bilateral lateral crural strut grafts and placement of a large composite skin cartilage graft into a pocket made along the left infracartilaginous incision. Bilateral costal cartilage spreader grafts were applied to reconstruct the middle nasal vault. Extended spreader grafts helped to stabilize a caudal extension graft.

Composite grafts can be used to replace deficient intranasal vestibular mucosa in secondary rhinoplasty patients. Those who have internal nasal vestibular stenosis require replacement of the scarred or contracted intranasal mucosa to correct the constricted airway.



In these patients severe stenosis is excised, leaving a large intranasal defect. A large composite graft can be harvested from the concha and placed in the mucosal defect.

If the stenosis is located in the nasal valve region, the composite graft can be hinged to fit the defect and re-create the nasal valve opening.



Composite grafts are sutured with 5-0 chromic sutures. Most are splinted to ensure proper positioning and healing.

Once the graft is healed, the nasal airway can be reestablished.

In most cases the donor site heals nicely.

POSTOPERATIVE CARE AND FOLLOW-UP

At the completion of surgery with an open approach, the transcolumellar incision is sutured precisely and an external cast is placed, overlying Steri-Strips. If vestibular splints are applied, they are removed the day after surgery, along with a small piece of absorbable packing from the nasal cavity. Sutures and the cast are routinely removed on the seventh postoperative day.

Postoperative edema can occur when perichondrium has been used to camouflage the nasal skeleton and grafts. Patients are reassured that this is the expected postoperative course to prevent unrealistic expectations. If supratip edema persists, approximately 0.1 to 0.4 ml of triamcinolone acetonide (10 mg/ml) can be injected into the subdermal tissue in the affected area. Repeat steroid injections may be warranted, but care is required to limit their frequency to reduce the risk of dermal atrophy. Supratip taping can help to achieve the desired postoperative nasal tip shape.

The most essential component of postoperative care is long-term follow-up. We recommend yearly examinations at a minimum for as long as possible (decades if feasible). Graft irregularities can be corrected with nasal exercises. Alternatively, minor irregularities can be corrected in a short office procedure under local anesthesia. Routine, long-term evaluation of rhinoplasty patients allows surgeons to determine whether the structural and aesthetic changes made during a revision procedure were effective in maintaining long-term function and appearance.

KEY POINTS

- Secondary rhinoplasty requires assessment of all changes in nasal structure and function that are a result of prior surgery.
- Preservation of the structural nasal framework is essential for successful long-term rhinoplasty results. Intraoperative weakening of structural components requires reconstitution at the time of surgery.
- An open rhinoplasty approach in revision surgery is recommended, because it allows full examination of the nasal structure and deficiencies to accurately determine and execute necessary changes under direct vision.
- Functional nasal defects after rhinoplasty include internal and external valve collapse. Internal nasal valve collapse can be corrected by the placement of spreader grafts, lateral crural strut grafts and/or alar batten grafts. Lateral crural strut grafts increase lateral wall support. Alar batten grafts and alar contour grafts help to correct external nasal valve collapse.
- We find that the addition of support and lining after excision of the scarred or contracted mucosal tissues provides the best improvement in nasal function.
- We have found that nonautologous grafts or implants yields an unacceptable risk for inflammation, infection, extrusion, pain, and excessive scar tissue.
- Autologous cartilage is the principal source of graft material for structural reconstruction in rhinoplasty. Nasal septal, auricular conchal, or rib cartilage is most commonly harvested.

- Setting tip projection can be achieved with a columellar strut graft, caudal septal extension graft, or an extended columellar strut graft. The decision to use a specific graft is determined by the intraoperative deficits and goals of the surgery. Stabilizing the nasal base is critical to minimizing postoperative loss of tip projection.
- A variety of structural grafts can help to achieve a natural-appearing nasal tip lobule. For example, a tip graft can help to set tip projection, hide tip asymmetries, reestablish nasal support mechanisms, and improve the stability of the medial crural–columellar strut complex.
- Alar retraction can be corrected with lateral crural strut grafts, repositioning of the lateral crura caudally, and use of a composite auricular graft if tension is excessive in the closure of the marginal incision.

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Advances in Secondary Rhinoplasty: Personal Perspective

Georges N. Tabbal ▪ Sean G. Boutros ▪ Nicolas G. Tabbal

Secondary rhinoplasty patients present with varying degrees of deformity, ranging from minor perceived flaws to severe nasal deformities. Similarly, patient attitudes vary from satisfied, though seeking improvement, to despondent, angry, or hostile. Some of the difficulty with secondary rhinoplasty occurs because a patient's attitude does not reflect the degree of actual deformity. The art of secondary rhinoplasty lies in the ability to identify and correct deformities so that patients will benefit both aesthetically and psychologically from the intervention.

The art of secondary rhinoplasty lies in the ability to identify and correct deformities so that patients will benefit both aesthetically and psychologically from the intervention.

EVALUATION OF THE PATIENT AND IDENTIFICATION OF THE DEFORMITY

Evaluation starts by obtaining a thorough history.[1] Surgeons should elicit complaints, symptoms, reasons for seeking a secondary intervention, and specific desires about nasal appearance. Information about prior surgeries is recorded, including the number and timing of previous operations. Patients often do not mention secondary revisions performed in office settings, because they tend to regard these events as touch-ups rather than real surgical procedures. Prior operative notes should be requested, although reports often do not reflect what was performed in the primary procedure. Full-face frontal, lateral, oblique, and basal view photographs are necessary and should be reviewed with the patient.

Photographs taken before the initial procedure can be helpful, because they alert surgeons to inherent and iatrogenic abnormalities. Computer imaging is often useful in demonstrating the potential surgical outcome; the patient's response helps to better assess desires. It is thus an excellent tool to identify patients who will not be satisfied with the outcome of a surgical correction of their nasal deformity. Although a patient's functional complaints are a critical component of the assessment, they are not the focus of this chapter.

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Evaluation of the Nose

Evaluation of the nose is divided into three broad categories to ensure a systematic review: (1) the dorsum, (2) the tip–lower third, and (3) the skin. Each area is assessed in isolation, followed by evaluation of the nose in its entirety, including the relation of the dorsum and tip. In addition, the nose is analyzed within the context of the entire facial structure, with special attention to the chin.

Dorsum

Nasal analysis can begin with assessment of the dorsum. On a frontal view, the dorsal aesthetic lines are evaluated. They should begin at the medial brow and end at the tip-defining points. Asymmetry of these lines may reflect an underlying deviation of either the nasal bones or the nasal septum with concomitant collapse of the upper lateral cartilage. Although these lines can be strong in men, in women they are best gently curved and subtle. The dorsum should be the appropriate width. A narrow dorsum can indicate underlying middle vault collapse with injury to the internal nasal valve. A wide dorsum can indicate inadequate or incomplete osteotomies. Dorsal height is assessed on a lateral view. Both underresection and overresection of the dorsum can occur, presenting as a dorsum that is too high or too low. The oblique view, generally referred to by patients as the *profile view,* can show subtle irregularities or abnormalities of dorsal contour and often highlights upper lateral cartilage collapse and irregularities at the keystone area. Dissimilar oblique views always indicate a nasal dorsal deviation.

Tip–Lower Third

The tip–lower third of the nose is much more difficult to evaluate, because its shape and position are interrelated with the dorsal position and the face in gen-

eral. Its assessment includes the projection, support, and rotation. Projection can be thought of as the height of the tip or the distance from the tip to the upper lip. Overprojection is found in larger noses that were insufficiently reduced during the primary operation. Underprojection can be inherent or a result of injury to the support structures of the tip during the primary rhinoplasty. Tip support is more difficult to assess. Fundamentally, it is the sum of the size and strength of the underlying cartilages and their fibrous attachments to the rest of the nasal structure. It is best assessed with palpation. Tips with poor support are often very mobile and plunge when the patient smiles. Tips with borderline support may appear to be acceptable preoperatively, but tend to drop over time postoperatively. Rotation is the relation of the tip to the lip and dorsum. It can be evaluated by the columellar-labial angle or the nostril show on a frontal view. An overrotated tip can be inherent or the result of excessive reduction of the caudal septum. An underrotated tip can be an inherent problem that was not corrected in the primary operation but may similarly result from reduction of tip support. Tip deviation can have numerous causes; most commonly, it is the consequence of caudal septal deviation, but it can also result from intrinsic asymmetry of the lower lateral cartilages or migration of tip grafts.

The tip–lower third of the nose is much more difficult to evaluate, because its shape and position are interrelated with the dorsal position and the face in general.

The shape of the tip varies and can be pinched, wide, asymmetrical, large, of insufficient volume, or amorphous. Irregularities are common, especially after the placement of tip grafts. Abnormalities can extend to the alae, which may be too high, low, notched, or collapsed. The base of the alae can be wide or narrow and may have unnatural contours as a result of prior resection. The columella can be retracted or hanging, wide, and scarred from prior incisions.

Skin

The skin can be thought of as the upholstery that drapes over the delicate framework of cartilage and bone. Although its nature and characteristics are difficult to manipulate, it has significant effects on the final result. Inherent difficulties include thick and sebaceous skin, as seen in many darker-skinned patients, and excessive scar tissue that resulted after dead space was created during prior operations. Patients who have had multiple operations, especially those in which skin manipulation was attempted, may have significant injury to the nasal soft tissues, including permanent thickening and scarring. Artificial implants often becoming encapsulated with scar or occasionally have eroded through the skin.

The skin can be thin and atrophic with damage to its appendages, thus reducing its vascularity and healing capabilities.

Identification of patients in whom secondary surgery should not be performed is as important as diagnosis of the nasal abnormalities that need to be corrected. Surgery should be deferred in patients who have unrealistic surgical goals and/or expectations, latent or overt hostility, or an unstable affect. In addition, if abnormalities are so severe that the prognosis for a successful surgical outcome is limited, then surgery is not performed. Surgeons who have performed secondary rhinoplasty can attest that many problematic patients could have been identified preoperatively and their operation avoided.[2,3]

Identification of patients in whom secondary surgery should not be performed is as important as diagnosis of the nasal abnormalities that require correction.

Finally, it is essential to conduct a thorough intranasal examination. The septum is palpated with a cotton tip applicator to assess its usefulness as a donor site for cartilage. This assessment is crucial given that previous operative reports may describe phantom septal procedures, dictated solely for insurance reimbursement purposes. Septal deviations, perforations of the septum, intranasal adhesions, and the status of the inferior turbinates should be documented. Finally, special emphasis is placed on examination of the internal nasal valves, particularly in patients with functional airway concerns.

TREATMENT

To understand secondary nasal surgery, the nose is regarded as an architectural entity. Most deformities are best understood and corrected if they are placed in this architectural model. Surgeons can best diagnose and treat saddle deformities, collapsed middle vaults, contracted tips, or overshortened noses by viewing the nose as a freestanding architectural structure. Identification of the missing structural beams is needed to devise an intuitive and practical plan for surgical correction.

To understand secondary nasal surgery, the nose is regarded as an architectural entity. Most deformities are best understood and corrected if they are placed in this architectural model.

Open Versus Closed Approach

The long-standing debate regarding an open versus closed surgical approach remains somewhat superfluous—a closed procedure is preferable to an open one if the surgical outcome is the same. A procedure that leaves no columellar scar is preferable to one that results in an excellent scar. However, the reality of nasal surgery and in particular secondary rhinoplasty is that some deformities are more predictably corrected through an open approach. An experienced nasal surgeon should be intellectually and technically versatile in both techniques. Surgeons who dogmatically perform only an open approach probably create an unnecessary columellar scar in too many patients, whereas those who perform only a closed approach deny some patients the superior outcome that is possible with an open approach.

Experienced nasal surgeons should be intellectually and technically versatile in both open and closed techniques.

After a deformity is identified and a reconstructive plan formulated, a surgeon must decide whether this plan is best carried out via an open or closed approach. In general, many dorsal abnormalities and some minor tip problems can be corrected with a closed approach. This approach does require experience and judgment, although it has some advantages beyond the prevention of a transcolumellar scar. A closed approach allows adequate visualization of the dorsum, domes, and lateral crura, without the loss of support that results from full degloving of the skin from the medial crura. In general, dorsal reduction/augmentation, trimming and suturing of the lower lateral cartilages, and placement of onlay grafts can be performed through a closed approach. Single spreader grafts can be placed using a closed approach. When multiple spreader grafts are necessary, an open approach is preferable because it allows more secure graft fixation.

Absolute indications for an open approach include a severely deviated nose that requires correction, an overshortened nose that needs to be lengthened, and an underprojected tip that can be treated with a columellar strut. The placement of struts in the columella via a closed approach can be problematic and result in unpredictable outcomes of inadequacy and tip asymmetry. An open approach is preferred if the lower lateral cartilages need to be reconstructed because they have been overresected or amputated or if anatomy or abnormalities are questionable. Under such circumstances the use of sutures can minimize the need for tip grafts and ensure secure graft stabilization. Furthermore, if a closed technique

is planned, the surgeon must be willing to convert it to an open procedure if visualization is inadequate or intraoperative findings are unexpected. The primary surgery failed because of either improper diagnosis or improper correction. Poor visualization of the anatomy may have been a contributing factor. If the added visualization provided by an open approach will help to meet the goal of deformity correction, it should be performed without hesitation.

Primary surgeries fail because of either improper diagnosis or improper correction. Poor visualization of the anatomy can be a contributing factor. Therefore, if the added visualization provided by an open approach will help to meet the goal of deformity correction, it should be performed without hesitation.

Donor Sites

Because most revision involves cartilage grafts, donor sites should be evaluated even if their use is not necessarily expected. In general, the septum is the best donor site; it is the most versatile, both as an onlay graft and as a structural graft. It has good handling characteristics and is flexible, strong, and generally straight. It may be absent in secondary cases, but in some situations, adequate cartilage is present and can be harvested secondarily.

It can be difficult to enter the correct plane between the opposing layers of dissected mucoperichondrium. In such cases, it is best to identify the path of dissection of the primary surgeon and choose an alternate one to the septum. For instance, if the surgeon approached the septum through the transfixion incision, it is usually easier to approach it secondarily from the dorsum by separation of the upper lateral cartilages. Spreader grafts can often be harvested with this approach if the horizontal septal strut is wide enough, without the need to enter the previously operated central area of the septum.

When the septum is not available or if additional cartilage is needed, the ear is the next best donor site. Ear cartilage is flexible and ideally shaped for alar and tip reconstruction. It is not as strong as septal cartilage, and its chief disadvantage is its intrinsic curvature, which makes it difficult to use as a dorsal graft, without morselization.[4] It is a remote donor site, yet it is in the same surgical field. Ear cartilage can be harvested with an inconspicuous scar on the posterior surface of the ear. It is important to harvest the floor of the concha and not significant amounts of the posterior wall. This maneuver yields more cartilage and simultaneously provides a straighter, flatter piece. The floor can easily be harvested up to the external auditory meatus without difficulty or fear of deforming the ear.

When the ear is the donor site for cartilage, the floor of the concha should be harvested and not significant amounts of the posterior wall.

Rib is the last choice for a donor site. Although it provides excellent volume of cartilage, it is a remote site and the cartilage is prone to warping. Rib cartilage has increased risks of harvest, including pneumothorax and lung injury. It is invaluable for a cartilage-depleted nose and for cases in which all other donor sites have been exhausted.

The septum is the ideal cartilage donor site, followed by the ear and rib.

Dorsal Correction

A high dorsum is the simplest deformity to correct. Proper dorsal height should be visualized and the dorsum gradually reduced. The dorsal bones are reduced with a sharp rasp, and the septum and upper lateral cartilages are sequentially lowered to match the bony level. This is done in a stepwise manner, with confirmation of the level of reduction by palpation after each maneuver. It is important to carefully reduce the upper lateral cartilages. As the skin envelope is retracted, the upper lateral cartilages are pulled upward. If they are trimmed to the level of the septum when the envelope is released, they will fall to a low level and result in a narrow dorsum with internal valve collapse. Previous operations on the septum with septal harvest close to the dorsum should be ruled out preoperatively before significant dorsal reduction is performed, because it can compromise the stability of the remaining dorsal L-strut.

A low dorsum results from aggressive primary dorsal reduction. Overresection of the bony dorsum is often associated with the use of a double-guarded osteotome. The deformity is treated with an onlay dorsal graft. These grafts bridge the gap at the site of dorsal overresection, and may start at the radix and extend as far as the supratip area. The grafts are widest at approximately the keystone area and taper proximally and distally for the most natural appearance. Septal cartilage is ideal for this purpose because it is usually flat, and with meticulous harvesting technique it can provide a graft approximately 3.5 cm long, the longest distance between the radix and the supratip area. Dorsal grafts can be layered and stacked with the edges tapered and lightly crushed. If stacked, the grafts are sutured together to maintain their orientation, and the dorsal pocket that is developed needs to be narrow and exactly in the midline. A narrow pocket will prevent the graft from shifting sideways, causing dorsal deviation.

For dorsal grafts, the dorsal pocket should remain narrow and be exactly in the midline. This will prevent the graft from shifting sideways, causing dorsal deviation.

Septal cartilage often is insufficient, and auricular cartilage must be used. In these patients, the largest possible conchal graft is harvested. From this large piece, the straightest portion or a gently curved portion is obtained. Occasionally two pieces with opposite curvature can be sutured together to balance the opposing forces and create a relatively straight piece.[5] Alternatively, if the grafts are to be layered, auricular cartilage can be used for the bottom layer and septal cartilage for the more visible, superficial layer. Finally, the use of morselized conchal cartilage wrapped in temporalis fascia can circumvent all the intrinsic shortcomings of the concha, including cartilage warping (see Chapter 16).[4]

Treatment of a narrow dorsum involves the placement of spreader grafts.[6] When planning spreader grafts, it is essential that the mucosa at the internal valve is not compromised. The upper lateral cartilages are dissected off the septum, and the spreader grafts are placed in the standard location. Multiple grafts can be placed next to one another if needed. They are secured to the dorsal septum and the edge of the upper lateral cartilages to prevent their dorsal migration.

Occasionally a narrow dorsum can be treated with onlay dorsal grafts. This is useful when the dorsum is both low and narrow, which is commonly the case. Under such circumstances, the pocket made to accommodate the graft should be narrow. With a narrow pocket, the skin is connected to the upper lateral cartilages. Insertion of the graft distracts the skin, which in turn pulls the upper lateral cartilages away from the septum and opens the internal nasal valve, thus simulating the action of spreader grafts. Onlay grafts can also be used in patients with a localized area of depression from a collapsed upper lateral cartilage, if the internal nasal valve has no associated functional impairment.

Patients often perceive collapse of the middle vault as bony excess at the distal border of the nasal bone. Resection of this excess would compound the problem and shift the hump to a more cephalad location, leaving an accentuated deficit in the middle vault.

The need for grafting can be confirmed by injection of a small amount of saline solution in the area to be augmented. This temporary simulation accurately demonstrates the expected correction and the need for augmentation rather than reduction.

A wide dorsum is usually the result of incomplete osteotomies at the initial surgery, and repeat osteotomies will effectively correct the problem. Osteotomies should be controlled and precise. Medial osteotomies are rarely needed if proper lateral osteotomies are performed. Once the lateral osteotomy is completed, gentle, persistent focal pressure on the nasal bone will displace the bone medially. The nasal bones should not be overmobilized, because this will remove lateral nasal support and result in internal valve collapse and a pinched nasal appearance.

Nasal deviation can be a challenging secondary problem to correct. It can result from deviation of the septum or deviation of the nasal bony pyramid.[7] The hallmarks of correction are the same as those in primary rhinoplasty. Septal deviation is most commonly the result of displacement of the septal cartilage and vomer to one side of the maxillary crest. The treatment is release of the septum and vomer from the maxilla, preserving at least a 10 mm wide L-strut from the perpendicular plate of the ethmoid to the anterior nasal spine. Once this central, curved septum is released, the dorsum will move toward the midline. However, this correction is seldom complete, and the nose generally will remain deviated. In such cases, the septum needs to be released at the anterior nasal spine and fixated in the midline. If this is done, sufficient dorsal cartilage must be maintained to prevent collapse of the nose. Finally, persistent nasal deviation is corrected with unilateral or asymmetrical spreader grafts that can serve as camouflage. A residual deviation of the distal dorsum can be corrected by anchoring the distal dorsal septum to a more proximal portion of the upper lateral cartilage on the concave side with a clocking suture.

The hallmarks of correction of nasal deviation are the same as those in primary rhinoplasty.

Tip–Lower Third Correction

Tip abnormalities can be difficult to correct, because diagnosis of the underlying cause of the problem can be especially elusive in secondary cases. For example, tip irregularities can result from improper suture placement, migrated tip grafts, asymmetrical resection of the lower lateral cartilages, or inherent twisting or mal-

formation of the cartilage. Diagnosis of the tip irregularity itself is seldom a problem; the underlying causes are the relevant factors to correct. Most secondary cases requiring significant modification of the tip necessitate an open approach for direct visualization of the aberrant anatomy, because the intraoperative findings can be totally unexpected. Once the lower lateral cartilages are visualized, two categories are evaluated: symmetry/shape and position.

Tip abnormalities can be difficult to correct, because diagnosis of the underlying cause of the problem can be especially elusive in secondary cases.

Asymmetry and malformation of the shape of the lower lateral cartilages are corrected by resection, augmentation, reorientation, or any combination of these. If the problem is limited to uneven resection of the cephalic scrolls and domal cartilages, resection to create symmetry is performed, if adequate cartilage is present for support of the structure. It can be performed through a closed approach. This is rarely the only cause of the problem, and further intervention is required. More often the cartilages are malpositioned and require reorientation with suture techniques. Intradomal sutures are used to modify the shape of each dome. These sutures can remove or hide kinks in the cartilage. They can also narrow widened domes, though if used too aggressively they can pinch the nasal tip. These techniques are often combined with interdomal sutures to unify the domes and refine the tip, creating symmetry. These maneuvers also cause some tip rotation, and this needs to be considered when the overall goals of the procedure are determined.

With incorrect primary techniques, the lateral crura and domes can be divided, weakened, or transected. In these cases and in cases of uneven resection, augmentation is required. Augmentation can be divided into two categories: augmentation to strengthen the existing cartilage and augmentation to replace missing cartilage. Strengthening is performed with invisible grafts. The exact graft or technique depends on the response of the cartilage to the techniques and the surgeon's experience. An alar strut graft with septal cartilage is very useful to strengthen the weakened lateral crura or to replace them if they are missing. Alar spreader grafts can be applied to correct shape asymmetry of the lateral crura and provide alar support.[8] They do, however, require the presence of intact lateral crura. Conchal cartilage replacement is often beneficial in nasal tip reconstruction because of its intrinsic curvature. A separate graft can replace each lateral crus. In cases in which the entire lower lateral cartilages have been sacrificed, a single piece can replace all the missing cartilage.

Alar rim grafts are especially useful in secondary cases. Often these patients will have notching of the alae from overresection of the lateral crura. Although reconstruction of the lateral crura will partially correct this, the resulting notching can be visible. Alar rim grafts, though small, will often correct this and improve tip stability by strengthening the lateral support of the nose. They can also be placed asymmetrically to correct notching of different levels.

With incorrect primary techniques, the lateral crura and domes can be divided, weakened, or transected. In these cases and in cases of uneven resection, augmentation is required.

The position of the tip needs to be established. The most versatile and powerful tool for this purpose is a columellar strut.[9,10] It can be used to augment projection and change rotation. A strut is best created from septal cartilage. It should be strong and straight. A pocket is dissected between the medial crura toward the anterior nasal spine. It is preferable not to dissect down to the maxilla. The strut is placed in the pocket, and the medial crura are pulled upward in the direction of desired tip rotation and projection. Needles are passed through the medial crura and strut to determine whether the desired effect is obtained, and the strut is secured with sutures.

On some occasions the caudal septum is excessive and in the midline. In these patients, an invagination technique is useful. However, if this maneuver is to be employed in patients who present with a deviated caudal septum, the surgeon must first correct the deviation and return the septum to the midline. The invagination (or tongue-and-groove) technique is performed via either an open or closed approach. It begins by dissection of the medial crura (which is performed in a retrograde fashion if a closed approach is employed). After the medial crura are freed, they are advanced around the caudal septum, in which the mucosa has been denuded. They are optimally placed and fixated with sutures. Needles are passed through as they are with a columellar strut. Notably, differential positioning can adjust tip rotation simultaneously. Although this results in a somewhat stiff tip because the mobility of the membranous septum has been abolished, the technique has the advantage of precise control of both tip projection and rotation. A modification of this technique involves the placement of a septal extension graft. Essentially a graft is applied to elongate the caudal septum and allow an invagination technique to be used. The potential downside of this graft if it is not diligently performed is pushing of the tip to the side of the septum on which it is placed.

CASE ANALYSES

After one prior rhinoplasty, this 37-year-old woman presented with an operated looking, contracted nose and significant functional problems. Her septum was unoperated. The patient's problems were related to overresection. Prevention of graft visibility was a challenge, because her nasal tissues were thin. They magnified the underlying structural deficits. Correction of her saddle deformity was dependent on the availability of a single piece of septal cartilage long enough to bridge the gap between the radix and supratip area. A meticulous septal harvest yielded a graft that was 35 mm long, obviating the need to place more than one dorsal graft in tandem. The junctional areas between such grafts, particularly in patients with thin nasal tissues, can be problematic.

The operative goals included the following:

- Correct the saddlenose deformity.
- Correct the collapsed middle vault.
- Correct the alar collapse and contracted tip.
- Straighten the uneven tip.
- Restore the retracted right alar rim to the proper level.

Surgical Plan

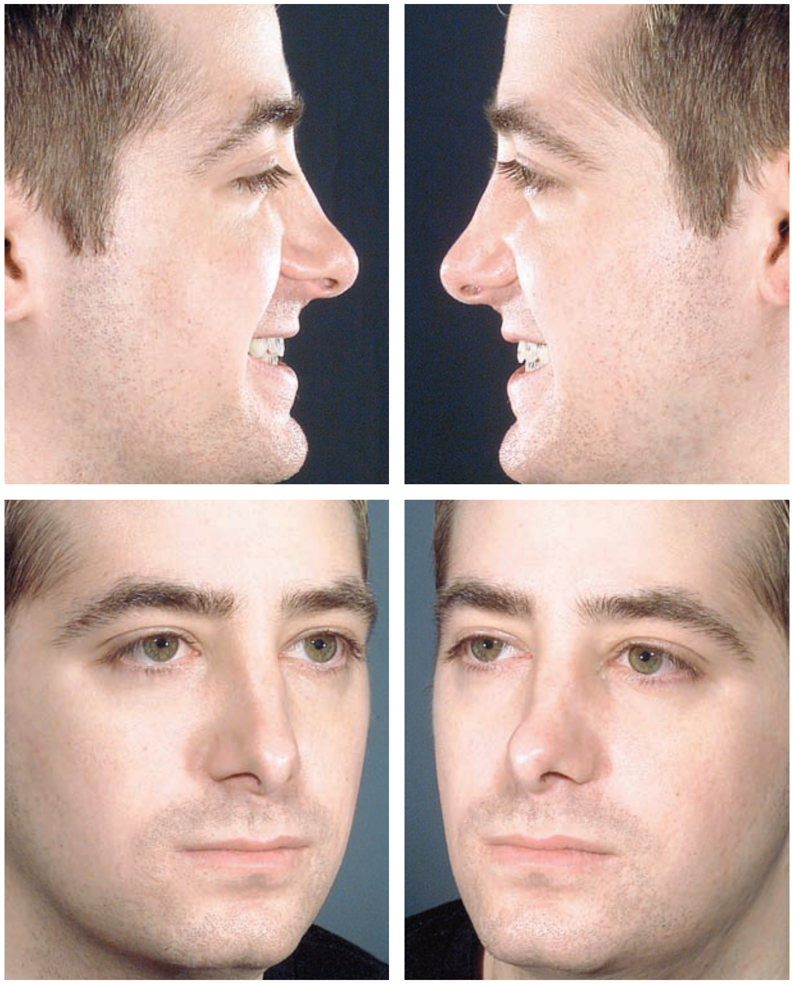
1. Use an open approach.
2. Place a dorsal graft.
3. Place spreader grafts.
4. Apply alar strut grafts.
5. Apply an alar rim graft (right).
6. Correct the tip deformity with a suture technique.

The patient is shown 1 year postoperatively. Her airway is open and her breathing problems are resolved. Enhancement of her dorsal height, middle vault width, and tip volume and restoration of proper alar rim level have substantially corrected all the aesthetic shortcomings. The edges of the visible dorsal graft are thinned to prevent their visibility. Spreader grafts successfully lateralize her collapsed upper lateral cartilages.

The lateral crura, which were found to be intact but were severely attenuated, are supported with long alar struts placed beneath the native cartilages. Retraction of her right alar rim is corrected with the use of a rim graft.

Preoperative evaluation of the status of the lateral crura is notoriously unreliable in secondary nasal surgery. The surgeon may think that the lateral crura are missing entirely, but discover that they are actually intact and concave.

This 27-year-old man had two prior rhinoplasties. His nose appeared twisted, and he had a right-sided airway obstruction. The dominant aesthetic problems were nasal deviation and a moderate saddle deformity.

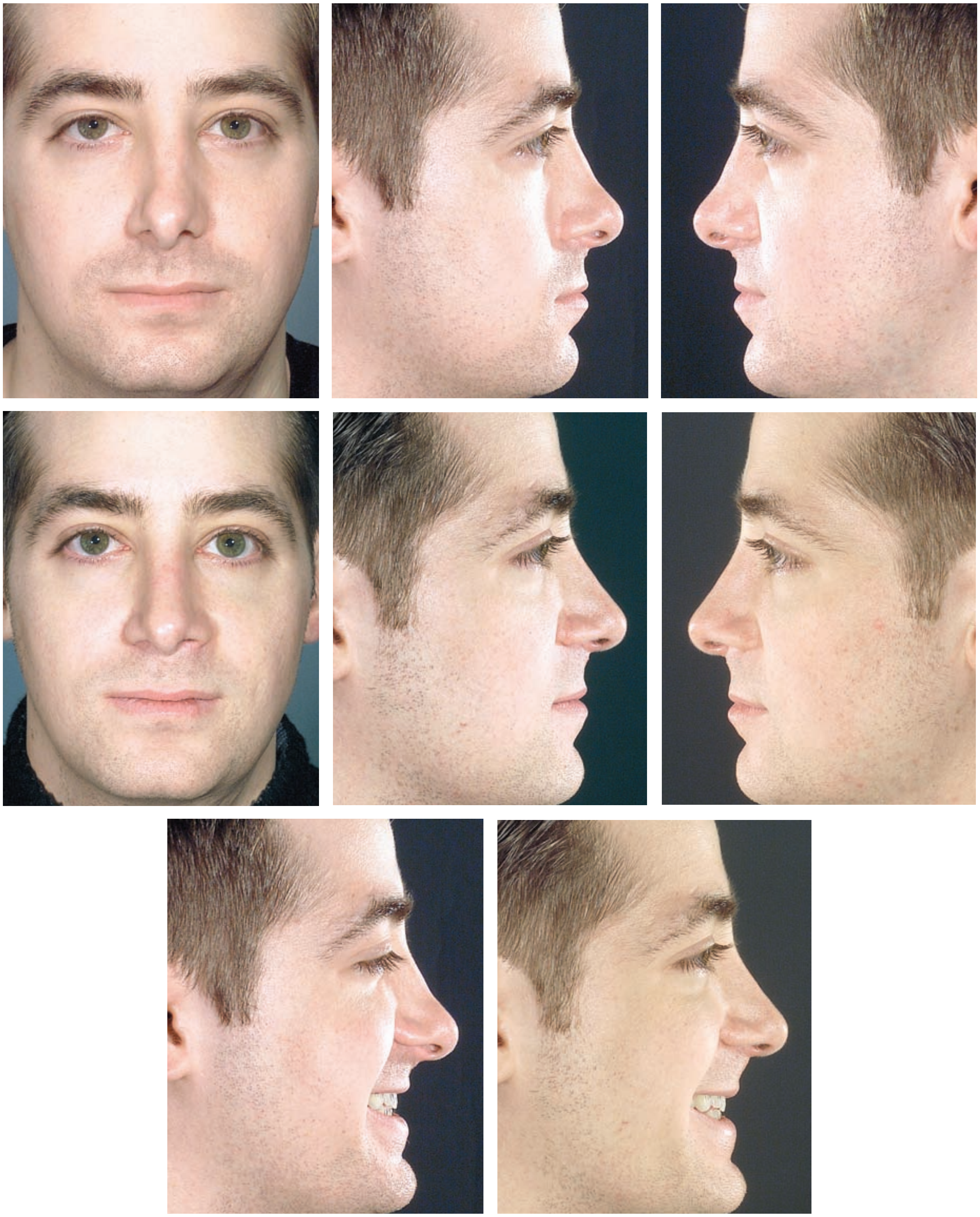


The operative goals included the following:

- Augment the overresected dorsum.
- Correct the dorsal deviation.
- Widen the collapsed middle vault.
- Correct the deviated tip.
- Strengthen the weak alar rim support.
- Straighten the deviated nasal septum.

Surgical Plan

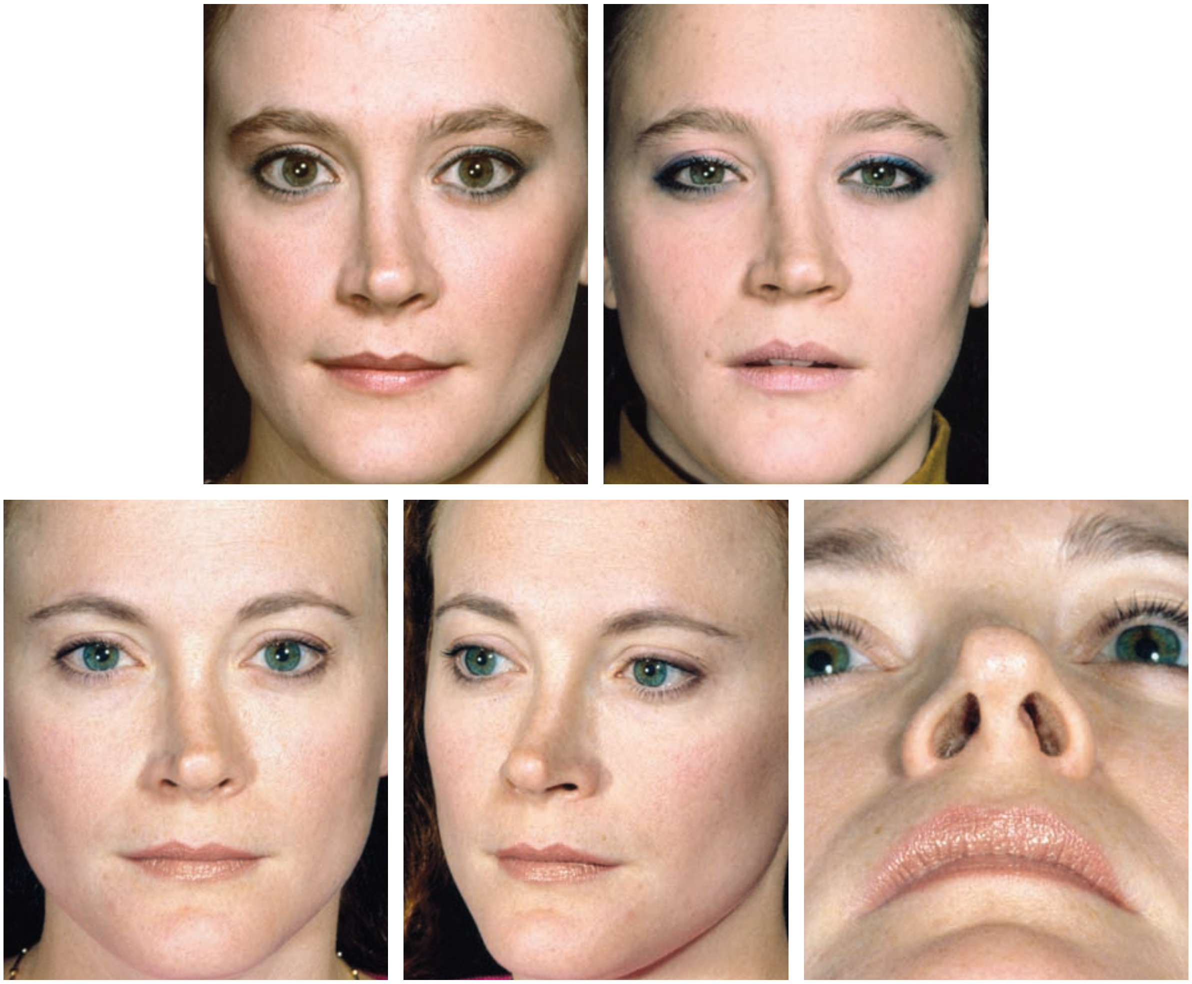
1. Perform submucous resection.
2. Apply a dorsal graft.
3. Place a right middle vault filler graft.
4. Place an alar rim graft (right).



The patient is shown 1 year postoperatively. The obstructive septum was virgin, allowing harvest of a large graft that was long enough to extend across the saddle deformity. The width of this graft was used as a means to widen the middle vault and improve the airway. A prerequisite to achieving this goal was the creation of a narrow dorsal pocket that maintained some of the attachments of the upper lateral cartilages to the overlying skin.

Bruised cartilage was placed along the dorsal graft on the right to achieve good dorsal symmetry.

A closed approach is acceptable in such cases, because dorsal augmentation is well controlled by the creation of a narrow, well-centralized dorsal pocket. No graft fixation is necessary. Dorsal augmentation and creation of symmetrical aesthetic dorsal lines have restored the normal masculine character to the patient's nose.



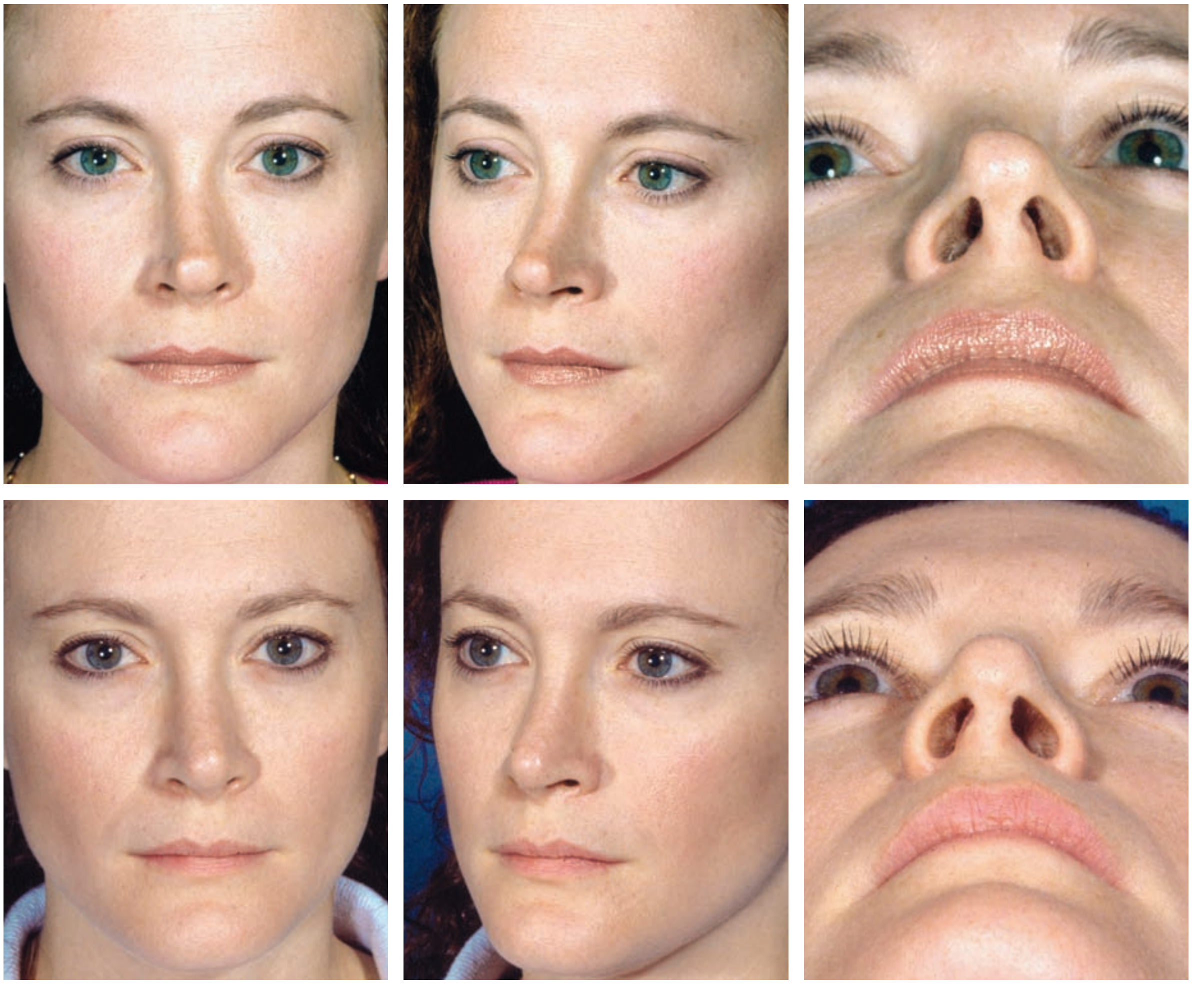
This patient had three previous rhinoplasties. Multiple cartilage tip grafts were placed in the last procedure. Twelve years after the last surgery, her nasal tip appearance was substantially unchanged. She had no functional complaints.

The operative goals included the following:

- Correct the contracted nasal tip.
- Provide tip symmetry.

Surgical Plan

1. Use an open approach.
2. Use suture techniques alone to correct the contracted nasal tip.



The patient is shown 1 year postoperatively. Her case demonstrates the advantages offered by an open technique in correcting nasal tip deformities. Previous tip surgery using a closed approach relied on filler grafts and failed to achieve adequate correction. Subsequent surgery with an open technique, however, resulted in an excellent outcome, surprisingly without the use of graft material. Visualization of the alar cartilages in their native state facilitates such creative corrections with suture techniques. Surgery through an open approach has made tip graft malpositioning and migration a rare occurrence. The added exposure allows centralization and fixation of tip grafts with far more desirable and predictable outcomes and a substantially reduced incidence of revision tip surgery.

This 30-year-old woman had two previous nasal procedures, the first of which was performed through an open technique. She complained of nasal tip deformity that appeared after the first procedure. Her septum was virgin. The tip had severe distortion of the soft triangles with sharp domes. Exploration of the tip revealed severe narrowing of the domes from previous placement of domal sutures. Her soft tissues were very thin and magnified the underlying distortion of the nasal tip cartilages.

The operative goals included the following:

- Improve the nasal tip deformity.
- Correct the slight nasal tip overprojection.

Surgical Plan

1. Use an open approach.
2. Harvest septal graft material.
3. Place long, transverse infralobular grafts.

The patient is shown 14 months postoperatively. The result was achieved with placement of a long, transverse infratip lobular graft made of lightly bruised septal cartilage. This graft extended across the nasal lobule and provided a buffer between the distorted alar cartilages and the overlying thin skin.

This camouflage technique was helpful, because it was impossible to undo the damage to the alar cartilages that had been caused by aggressive suture technique during the primary operation. Although the patient had a simultaneous otoplasty, the conchal cartilage was not used for this reconstruction because of its poor handling qualities when it is attenuated.

This 39-year-old woman had undergone one previous closed nasal procedure. Her septum was virgin and deviated. The bony pyramid was wide with a palpable open roof. Her middle vault was weak. An inverted-V deformity was visible, mainly because the wide bony pyramid had not been narrowed during the previous procedure. Although her septal angle was high, it was evident that tip support was lacking. In addition, the nasal tissues were somewhat thick and scarred, particularly in the tip area.

The operative goals included the following:

- Correct the middle vault to include narrowing of the bony pyramid.
- Close the open roof deformity.
- Correct the nasal tip underprojection.
- Lower the septal angle.
- Enhance nasal tip support.

Surgical Plan

1. Use an open approach.
2. Perform bilateral nasal osteotomies.
3. Place dorsal spreader grafts.
4. Conservatively reduce the nasal dorsum.
5. Enhance tip support with a columellar strut.

Postoperatively the patient has strong, symmetrical nasal dorsal lines and a straight nasal dorsum. Her nasal tip support is stable when she smiles. Her nasal tissue appears less bulky and heavy, because the available skin envelope was expanded through an increase in tip projection and widening of the middle vault.

This case demonstrates that underprojection of the tip can be camouflaged by a high septal angle.

KEY POINTS

- The art of secondary rhinoplasty lies in the ability to identify the correct deformities so that patients will benefit both aesthetically and psychologically from the intervention.
- Patients often do not mention previous secondary revisions performed in office settings, because they tend to regard these events as touch-ups rather than real surgical procedures.
- The tip–lower third of the nose is much more difficult to evaluate, because its shape and position are interrelated with the dorsal position and the face in general.
- Identification of patients in whom secondary surgery should not be performed is as important as diagnosis of the nasal abnormalities that require correction.
- To understand secondary nasal surgery, the nose is regarded as an architectural entity. Most deformities are best understood and corrected if they are placed in this architectural model.
- Experienced nasal surgeons should be intellectually and technically versatile in both open and closed techniques.
- Primary surgeries fail because of either improper diagnosis or improper correction. Poor visualization of the anatomy can be a contributing factor. Therefore, if the added visualization provided by an open approach will help to meet the goal of deformity correction, it should be performed without hesitation.
- When the ear is the donor site for cartilage, the floor of the concha should be harvested and not significant amounts of the posterior wall.
- The septum is the ideal cartilage donor site, followed by the ear and rib.
- For dorsal grafts, the dorsal pocket should remain narrow and be exactly in the midline. This will prevent the graft from shifting sideways, causing dorsal deviation.
- Patients often perceive collapse of the middle vault as bony excess at the distal border of the nasal bone. Resection of this excess would compound the problem and shift the hump to a more cephalad location, leaving an accentuated deficit in the middle vault.
- The hallmarks of correction are the same as those in primary rhinoplasty.
- Tip abnormalities can be difficult to correct, because diagnosis of the underlying cause of the problem can be especially elusive in secondary cases.
- With incorrect primary techniques, the lateral crura and domes can be divided, weakened, or transected. In these cases and in cases of uneven resection, augmentation is required.
- Preoperative evaluation of the status of the lateral crura is notoriously unreliable in secondary nasal surgery. The surgeon may think that the lateral crura are missing entirely, but discover that they are actually intact and concave.

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Achieving Consistent Results in Secondary Rhinoplasty

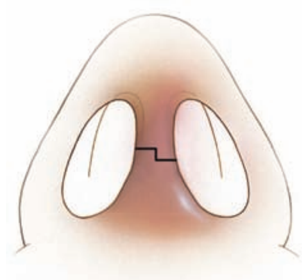
Rod J. Rohrich ▪ Michael R. Lee ▪ Jamil Ahmad

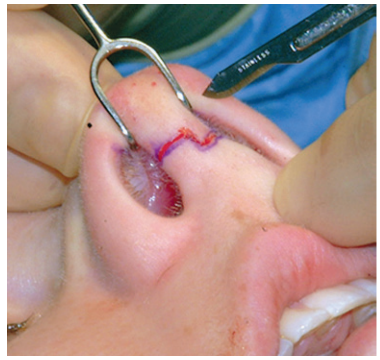
Secondary rhinoplasty should be viewed as a dissimilar operation compared with primary rhinoplasty because of the complexity and distinct set of challenges associated with reoperative surgery of the nose.[1] Surgical challenges often include alteration of the native anatomy, typically involving weakened or missing supportive structures, the presence of scar and loss of soft tissue elasticity, and depleted cartilage stores. Establishing patient rapport may also require additional effort and communication, since the patient has already experienced an unsatisfactory outcome. Collectively, these obstacles make secondary rhinoplasty an even more challenging operation for the rhinoplasty surgeon.

Secondary rhinoplasty is often complicated by alteration of the native anatomy, typically involving weakened or missing supportive structures, the presence of scar and loss of soft tissue elasticity, and depleted cartilage stores.

Success in secondary rhinoplasty begins with communication between the surgeon and patient. Patients may display a variety of nasal deformities following rhinoplasty, and the goals of surgery should be clearly delineated. Educating patients about the limitations of correction for their specific problem is of paramount importance. Successive operations in rhinoplasty can lead to diminishing returns, since each surgery creates greater scar formation and ultimately reduces the predictability of the outcome. Such issues underscore the importance of setting realistic goals for the secondary surgery and determining whether it is possible to achieve a result that will meet the patient's expectation.

BACKGROUND





The open rhinoplasty approach became a topic of discussion in the early 1980s. Before that time, the closed approach was the standard technique for most nasal surgery. Through a combination of internal nasal incisions, the nasal cartilage and bone was manipulated. The closed approach for secondary rhinoplasty provided limited ability to inspect the underlying structures and determine the cause of the external deformity. Additionally, this approach relied, at least in part, on manipulating the underlying structures without direct visualization.

In contrast, the open approach allows exposure and direct visualization of the nasal osteocartilaginous framework, enhancing both diagnosis and treatment. With elevation of the nasal skin and soft tissue envelope, scar tissue can be released or excised, the nasal framework can be examined and repositioned or reconstructed, and grafts can be placed and secured. Both diagnosis and treatment are superior with the open approach for secondary rhinoplasty. The advantages of the open approach were outlined in 1987 and still remain valid today.[2]

Advantages and Disadvantages of the Open Approach

Advantages
- Binocular visualization
- Evaluation of complete deformity without distortion
- Precise diagnosis and correction of deformities
- Allows use of both hands
- More options with original tissues and cartilage grafts
- Direct control of bleeding with electrocautery

Disadvantages
- External nasal incision (transcolumellar scar)
- Prolonged operative time
- Protracted nasal tip edema
- Columellar incision separation and delayed wound healing
- Suture stabilization of grafts often required

Although discussion continues among surgeons regarding the approach that optimizes treatment in primary rhinoplasty, the open approach is now most commonly used in secondary rhinoplasty.[3] We recently described 25 years of experience using the open approach in secondary rhinoplasty, highlighting the evolution of surgical concepts and techniques that have proved reliable.[1] Anatomic studies and intraoperative analyses have certainly furthered knowledge specific to secondary rhinoplasty.[1,2,4-7] The open approach has been established as a reliable means to optimize outcomes in secondary rhinoplasty.

The open approach for secondary rhinoplasty allows maximal exposure, aiding in diagnosis and treatment.

INDICATIONS AND CONTRAINDICATIONS

Although the open approach is preferred for secondary rhinoplasty, there are some general contraindications related to the patient's suitability for undergoing secondary rhinoplasty.

Indications and Contraindications to Secondary Rhinoplasty

Indications
- Aesthetic deformity
- Nasal dysfunction from an anatomic deformity

Contraindications
- Patient is physically unable to undergo operation
- Patient is emotionally unable to undergo operation
- Uncontrolled medical condition present
- Patient has unrealistic expectations
- Body dysmorphic disorder suspected
- Patient demonstrates poor surgical motivation
- Ongoing illicit drug use is confirmed or suspected

PREOPERATIVE ASSESSMENT AND PLANNING

History

A comprehensive history should be obtained with details of prior operative goals and outcomes.[4,8] Reviewing previous operative reports is desirable, but in general, these are of limited utility, since they lack adequate detail. Age is a consideration in patients requiring ear or rib cartilage grafting, because calcification of rib cartilage may limit its utility.

Communication between the surgeon and patient is of paramount importance in secondary rhinoplasty. Patients must understand the limitations of secondary rhinoplasty and have realistic expectations. Moreover, documentation of these discussions is crucial. It is advisable to determine and document what specific problems the patient wishes to have corrected and to ask the patient to identify which problems are most concerning. This allows the surgeon to prioritize the goals that are most important to the patient.

Caution must be exercised in treating a patient who is overly concerned with a subtle deformity. These must be addressed on a case-specific basis, but this type of patient tends to be unhappy regardless of outcome. Patients may be understandably upset with their previous surgeon if they feel that the result did not meet their expectations. Over time, this should subside, and it is important to allow the patient to reach a state in which he or she is emotionally suitable for secondary rhinoplasty. Operating on a patient who remains emotionally labile will only increase the likelihood of further dissatisfaction.

Communication between the surgeon and patient in exploring what is achievable and setting realistic expectations is of paramount importance. One should avoid operating on patients with unrealistic expectations or who are emotionally unsuitable for secondary rhinoplasty.

Photographs should be taken both for further inspection and nasofacial analysis and documentation of preoperative deformities. In many instances, it is useful to review these preoperative photos with the patient to specifically discuss deformities and identify goals for surgery. Photographs assist in surgical planning and may also be referenced during the operation. Follow-up photographs should be taken at each visit again for documentation and surgeon study.

Systematic Nasal Analysis

Facial and nasal analysis were discussed in Chapter 6. In this chapter we will focus on common deformities seen in secondary rhinoplasty. These deformities usually result from one or a combination of the following[1]:

- Excessive weakening or resection of the osteocartilaginous nasal framework
- Malposition of the native anatomic structures or grafts that have been previously placed
- Undertreatment of prominent anatomic structures

Diagnosis of existing deformities begins with nasofacial assessment based on aesthetic ideals. Standard views of the nose are used to carry out a systematic nasal assessment.[4]

Systematic Nasal Analysis

Frontal View
Facial proportions
Skin type/quality: Fitzpatrick type, thin or thick, sebaceous
Symmetry and nasal deviation: Midline, C-, reverse C-, S-, or S-shaped deviation
Bony vault: Narrow or wide, asymmetrical, short or long nasal bones
Midvault: Narrow or wide, collapse, inverted-V deformity
Dorsal aesthetic lines: Straight, symmetrical or asymmetrical, well or ill defined, narrow or wide
Nasal tip: Ideal/bulbous/boxy/pinched, supratip, tip-defining points, infratip lobule
Alar rims: Gull-wing shaped, facets, notching, retraction
Alar base: Width
Upper lip: Long or short, dynamic depressor septi nasi muscles, upper lip crease

Lateral View
Nasofrontal angle: Acute or obtuse, high or low radix
Nasal length: Long or short
Dorsum: Smooth, hump, scooped out
Supratip: Break, fullness, pollybeak
Tip projection: Overprojected or underprojected
Tip rotation: Overrotated or underrotated
Alar-columellar relationship: Hanging or retracted alae, hanging or retracted columella
Periapical hypoplasia: Maxillary or soft tissue deficiency
Lip-chin relationship: Normal, deficient

Basal View
Nasal projection: Overprojected or underprojected, columellar-lobular ratio
Caudal septal deviation
Nostril: Symmetrical or asymmetrical, long or short
Columella: Septal tilt, flaring of medial crura
Alar base: Width
Alar flaring

Comprehensive systematic nasal analysis facilitates identification of nasofacial disproportions and imbalances and helps to establish the goals for rhinoplasty surgery.

Frontal View

Analysis begins with evaluation of the anterior nasal view. Nasal deviation is noted, with attention to shape and location. Deviation of the upper third may suggest residual or recurrent bony deviation. The cause of a deviated middle or lower third can be more confounding and is often the result of cartilage malposition. Failure to adequately straighten a deviated dorsal septum during the initial operation or to reinforce correct positioning with graft placement in select cases may lead to this deviation. If cartilage grafting of the dorsum was previously done, there may be warping with external distortion. Asymmetry of the lower lateral cartilages and/or septum may lead to deformity of the lower third, compromising overall nasal aesthetics.

When soft tissue attachments that support the upper lateral cartilages are attenuated, the midvault is at risk for collapse. This often results from aggressive treatment of the nasal dorsum in which the upper lateral cartilages were not protected or reattached. Upper lateral cartilages descend further beneath the more cephalic nasal bones and externally create an inverted-V deformity. Such a deformity disrupts the dorsal aesthetic lines. Functionally, this leads to narrowing or stenosis of the internal nasal valve.

Various problems with the nasal tip may be seen. Previously placed tip grafts may thin the overlying skin with time and become quite noticeable. Grafts that are malpositioned or that have migrated may compromise tip aesthetics. Asymmetrical position of the domal cartilages can result from poor suture placement during the previous operation. This underscores the importance of correct placement of interdomal and transdomal sutures. Infratip lobular excess may also result from any significant cartilage displacement into the infratip region.

The nasal base may display alar notching or retraction. Most commonly these deformities result from overzealous resection of the lateral crura. Diminution or excessive resection of lateral crura may also lead to a functional deficit of the external valves. An original intranasal incision close to the nasal rim may also lead to such deformity when the tissue contracts during wound healing.

Lateral View

Assessment of the lateral nasal profile begins cephalically at the nasofrontal angle. Low positioning of the radix may be the result of bony vault overresection or graft resorption. Residual or recurrent dorsal fullness at the rhinion is not

uncommon. There may be a residual hump from inadequate treatment. More commonly, hump formation recurs weeks to months after surgery. Although not completely understood, this most likely results from bony regeneration of stimulated periosteum or differential settling of the cartilaginous hump compared with the more rigid bony abutment. Palpation of the dorsum assists in diagnosing the irregularity and its structural causes.

Distally the supratip is evaluated. Failure to establish adequate tip support during prior operations may produce several problems. A discrepancy between dorsal height and tip projection results in a pollybeak deformity when the anterior septal angle is above the nasal tip. Equivalent height of the dorsum and tip precludes the desirable supratip break in females. Alternatively, a pollybeak deformity may develop during the late recovery period after rhinoplasty from a failure to establish adequate tip support to withstand forces such as scar contraction in the healing phase.

The projection and rotation of nasal tip itself is evaluated. Infratip anatomy and the alar-columellar relationship is assessed. Frequently seen in candidates for secondary rhinoplasty is excessive caudal septum/soft tissue or retracted alae leading to a hanging columella or excessive columellar show, respectively.

Basal View

Observation of the basal view focuses on the ala and columella. Alar notching, retraction, or external valve collapse should be noted. Asymmetrical or distorted alar walls are common in secondary rhinoplasty, and these should be addressed in surgery.

The medial nostril is formed by the lateral columellar border and should be inspected. Lateral columellar contour and shape creates the basal aesthetic lines analogous to the dorsal aesthetic lines on frontal view. A smooth contour and symmetrical shape of these lines creates nasal harmony as the dorsal aesthetic lines transition the upper lip to nasal tip. Distortion of this region may result from malposition of the caudal septum or medial crura. Soft tissue abnormality can also compromise the aesthetic appearance.

The nasal skin envelope should be examined and the original scar assessed. The presence of a prominent or unsightly scar is noted, as is poor placement of the original scar.

Internal Nasal Examination

Internal nasal examination begins at the nasal base. Examination of structures should be completed at baseline and during respiration. The external nasal valve is assessed as is the internal nasal valve both on regular and forced inspiration. Malpositioned struts placed during the initial operation may cause stenosis of either valve.

The nasal septum should be inspected. Septal integrity and the availability of cartilage for grafting should be noted. Deviation of the nasal septum should be noted, as well as the presence of any perforations or synechia. Finally, any residual or recurrent inferior turbinate hypertrophy should be assessed. Adequate illumination should be used when performing the internal nasal examination.

Evaluation of the secondary rhinoplasty patient requires comprehensive external nasal analysis and internal nasal examination. Potential cartilage donor sites such as the septum, ear, and rib should also be examined.

Computer Imaging

The use of computer imaging software can improve communication between surgeon and patient in terms of planned changes in nasal appearance. Although not imperative, use of imaging may allow patients to better convey their desired appearance and guide surgical planning. More importantly, this serves as an opportunity for the surgeon to assess the patient's level of expectations and whether they are realistic for secondary rhinoplasty surgery.

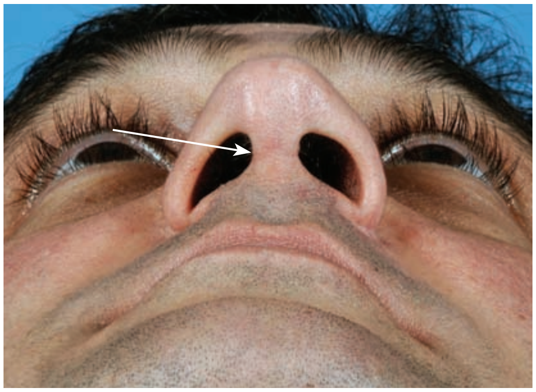
Computer imaging provides an opportunity for the surgeon to assess the patient's level of expectations and whether they are realistic for secondary rhinoplasty surgery.

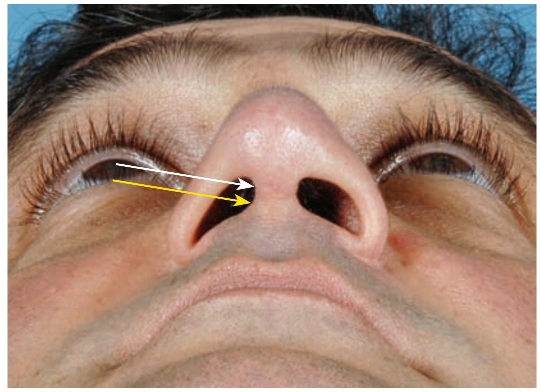
OPERATIVE TECHNIQUE

Incision

If the original scar healed in an unsightly manner it may be cautiously revised when creating the transcolumellar incision. Such a maneuver requires adequate skin volume to bridge the gap of an excised scar and yet deliver a tension-free closure. If this is in doubt, no attempt to treat the scar is made.

It is important to remember the relationship between changes in tip projection and the skin envelope. If the projection is to be increased, more will be asked of the skin to accommodate. Conversely, if nasal projection is being decreased, there may be excess columellar skin at the conclusion of the operation.

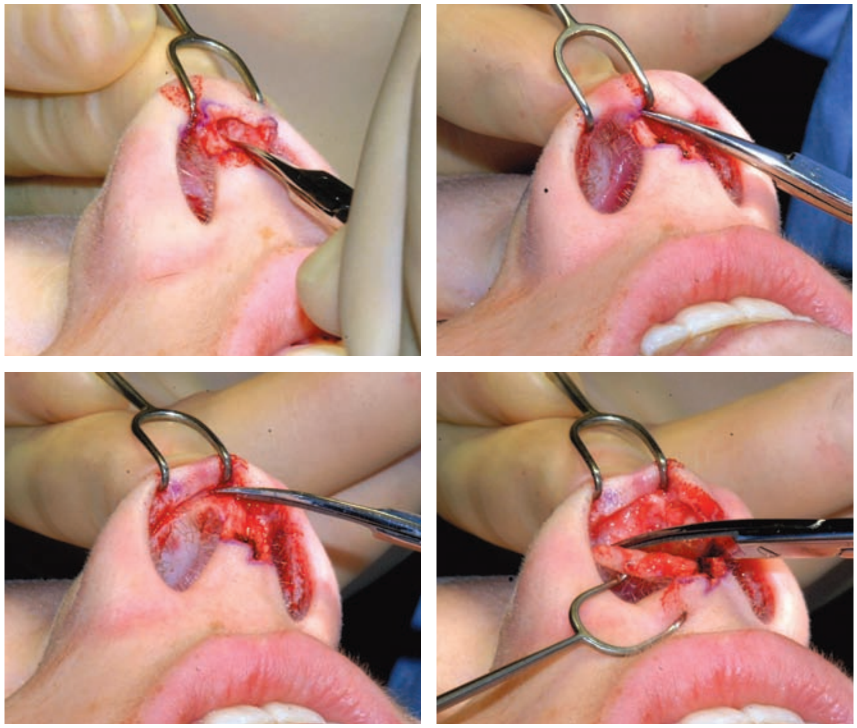




If the original incision is in a poor location, a new incision may be created in the desired location.[9] The incision should be made at the narrowest portion of the columella. Vast blood supply to the nasal skin allows this maneuver. Caution should be exercised when an aggressive resection of the alar base has been previously done. Incisions 2 to 3 cm above the alar groove may be indicative of a sacrificed lateral nasal artery blood supply.

Elevation of Skin and Soft Tissue Envelope

Connection of the transcolumellar incision with bilateral infracartilaginous incisions allow for elevation of the skin envelope.



Dissection begins directly on the medial crural surface and continues inferior to superior toward the domes. A second area of dissection is started laterally on the surface of the lateral crura and proceeds in a lateral to medial direction toward the domes. The two areas are then connected over each dome, preserving the nasal lining deep to the soft triangle. Nasal skin along the columella and soft triangle may be thin and should be handled with meticulous care. The skin and soft tissue envelope is then elevated toward the keystone area with a combination of sharp dissection and spreading. Dissection should begin and remain at the cartilage surface until the entire cartilaginous nose is exposed.

Scar formation complicates opening the nose in secondary rhinoplasty. Adherence of the underlying cartilage to the skin envelope obliterates natural tissue planes. The nose must be opened cautiously, since the lower lateral cartilages are at risk for damage. If the cartilages are cut or weakened, this should be repaired during the operation.

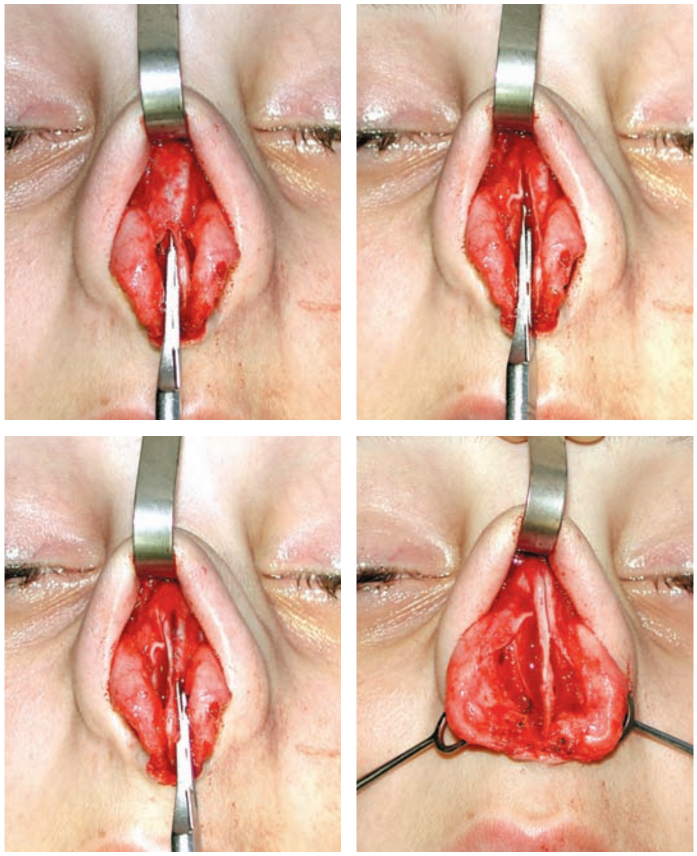
A Joseph periosteal elevator is used to expose the nasal bones. Retracted or limited skin pliability may also limit surgical options.

Opening the nose in secondary rhinoplasty should be performed in a meticulous manner as scar obliterates natural tissue planes.

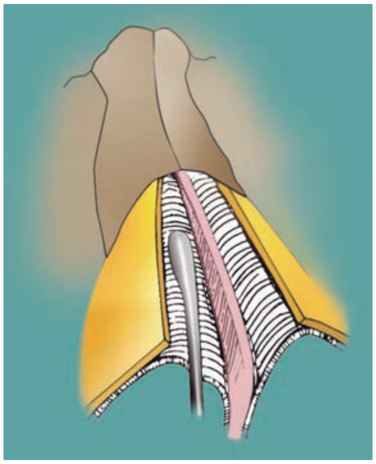
Retraction of the elevated skin envelope allows inspection of the entire cartilaginous framework. It is common to find a layer of scar tissue covering the cartilaginous framework, and this should be sharply excised to expose the cartilages, which will also enhance contour and definition. After exposure, the structural causes of external deformities are identified. In some cases, onlay grafts are present and contribute to the deformity; these should be removed and saved in saline solution if they may be needed later.

It is common to find a layer of scar tissue covering the cartilaginous framework, and this should be sharply excised to expose the cartilages; this will also facilitate contour and definition.

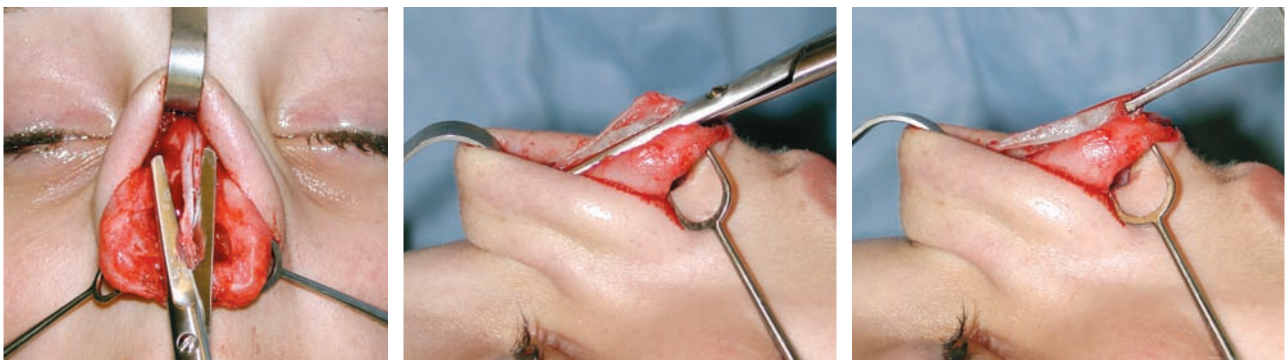
Component Approach to the Dorsum



A component approach to the dorsum is used to separate the upper lateral cartilages from the septum and incrementally manipulate each individual structure.[10-12] Dissection continues to identify the anterior septal angle. This dissection can be facilitated by displacing the lower lateral cartilages downward and noting anterior septal angle prominence. Once the anterior septal angle is identified, a scalpel is used to score the septal cartilage, and a Cottle elevator is used to elevate bilateral submucoperichondrial and submucoperiosteal flaps. Elevation continues on the undersurface of the upper lateral cartilages where they join the dorsal septum to preserve the mucosa of the internal nasal valves. A scalpel is then used to separate the upper lateral cartilages from the dorsal septum.



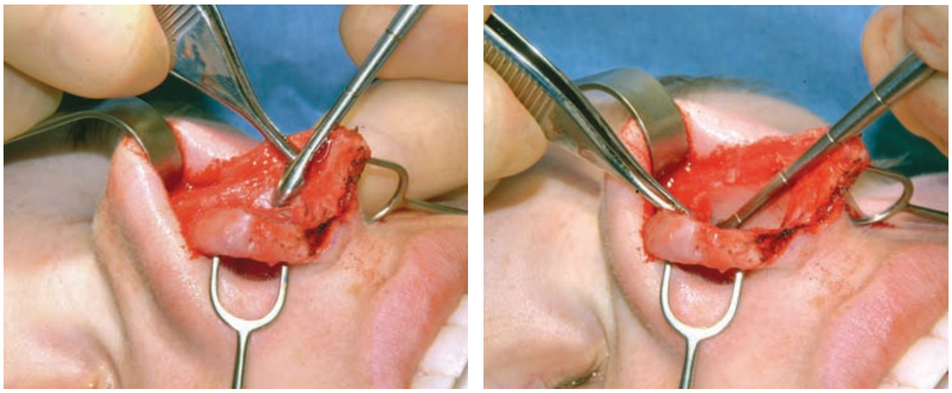
This process optimizes control and allows maximal preservation of anatomic structures. The mucosa of the internal nasal valve is also preserved to maintain a dorsal pocket and any grafts separated from the internal nasal cavity and, also, prevent cicatricial stenosis of the internal nasal valve.



If dorsal reduction is needed this is also performed in a component approach.[10-12] The cartilaginous septum is reduced sharply and this resected cartilage can be used for grafting as well.

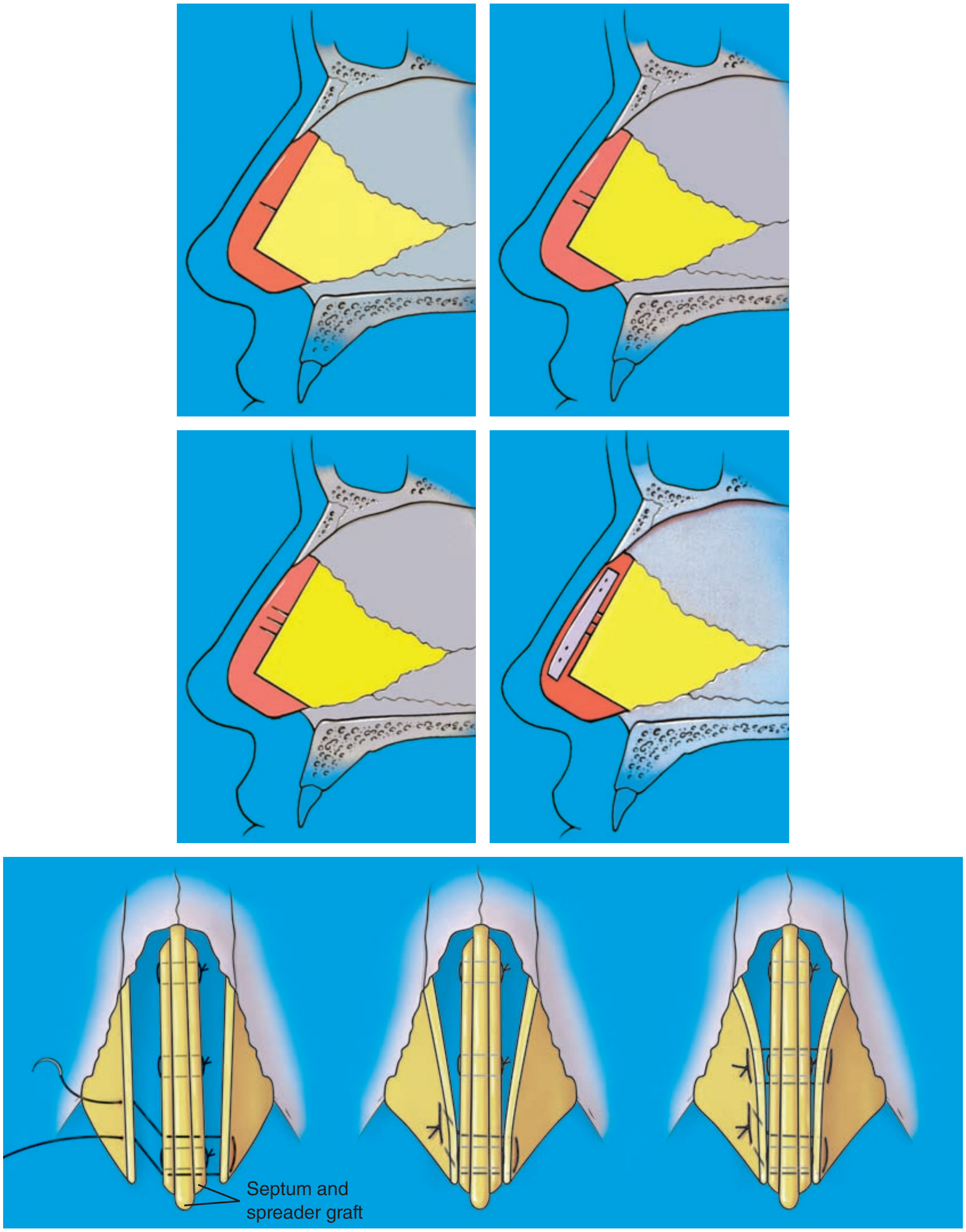
Following reduction of the cartilaginous septum, the bony hump is rasped. Three-point palpation test is used to assess the mid dorsum and bilateral dorsal aesthetic lines so that these areas both look and feel smooth. An incremental approach to reducing the cartilage and bone allows for precision and control in this area.[10-12]

Addressing the dorsum is completed before any potential septal resection or harvest; a 10 to 15 mm L-strut should be preserved to maintain external nasal support. If this volume of nasal support does not exist, it must be rebuilt with cartilage grafts. Rib cartilage is the preferred tissue for major rebuilding of nasal infrastructure.



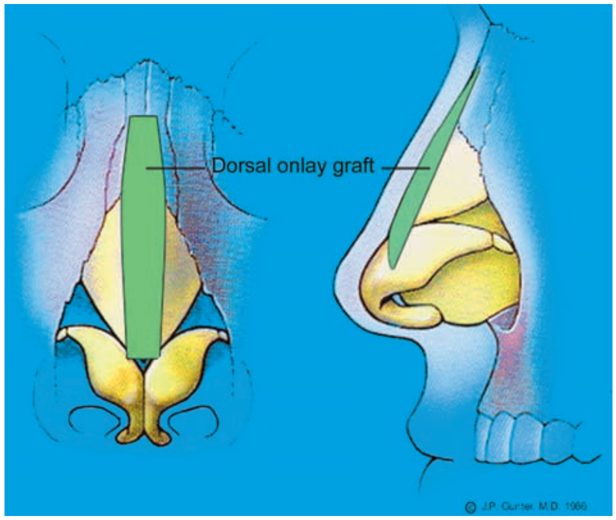
After the dorsum has been reduced, the posterior septum can be exposed if septal reconstruction or cartilage harvest is required, as is a common indication during secondary rhinoplasty.[13,14] The submucoperichondrial and submucoperiosteal flaps are elevated posteriorly to expose the septum. With the septum exposed, septal reconstruction can correct septal deviation, and any septal cartilage is harvested for use as grafts. Frequently in secondary rhinoplasty, problems including caudal septal deviation and posterior septal bony spurs and/or deviation are encountered that were not corrected during prior surgeries. Correction of the caudal septum may require release from the anterior nasal spine and repositioning with suture fixation. Residual deviations should be treated without compromising nasal support.

The component approach to the nasal dorsum optimizes preservation of cartilage and mucosa preventing external deformities of the midvault and dysfunction of the internal nasal valves.



Deviation of the dorsal septum is commonly corrected when the upper lateral cartilages are released from the dorsal septum. If this does not correct the deviation, it may be necessary to weaken the stress forces by 50% partial-thickness cuts to the posterior aspect of the L-strut combined with splinting spreader grafts.[13,14]

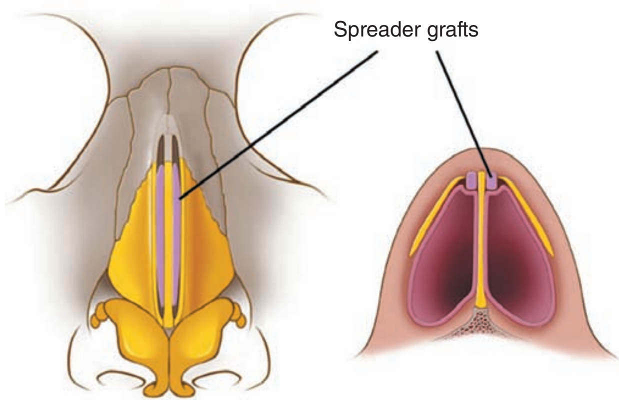
The goal is to straighten and strengthen the nose while maintaining or creating smooth dorsal aesthetic lines and an ideal nasal profile. Clocking sutures and other suture techniques can improve mild deviation.[15]



If dorsal augmentation is needed, cartilage grafting is preferred. Although dorsal onlay grafts of septal cartilage can be used, there usually is not enough septal cartilage for this and other required grafts.[16] Substantial dorsal augmentation can be achieved with rib cartilage; more recently, we have used temporal fascia–wrapped diced cartilage with good results.[17,18] Rib grafts for dorsal augmentations are at risk for warping, and this should be accounted for when placing the graft. Diced cartilage grafts are at risk for contour deformity and malposition but do seem to maintain volume over time.

Augmentation with allografts is an option, but we have not used these because of the increased risk of exposure and explantation, especially in a secondary rhinoplasty patient, in whom the skin and soft tissue envelope may be thinner and less compliant.

Nasal Airway



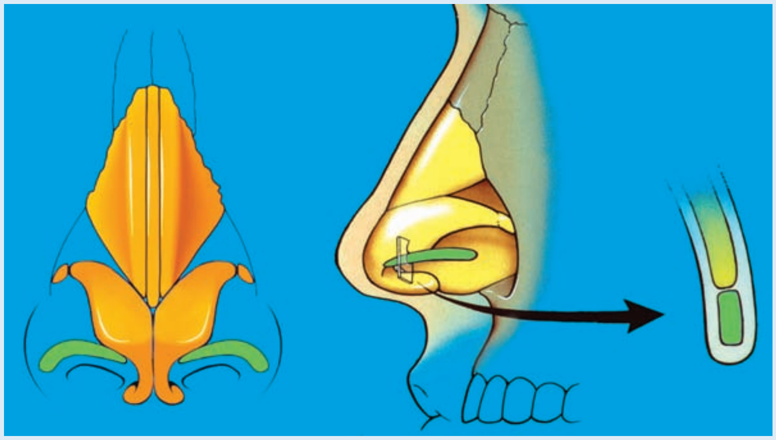
Treatment of a clinically obstructed nasal airway requires straightening the septum, reducing hypertrophied inferior turbinates, and reconstructing the internal and external nasal valves.[19-21] Although we use spreader grafts less frequently in primary rhinoplasty, spreader grafts are often used in secondary rhinoplasty to reconstruct the internal nasal valve.[1,22,23] Composite dorsal reduction can remove excess cartilage at the midvault, creating both internal valve obstruction and poor definition of the dorsal aesthetic lines. Although suture techniques have been described, spreader graft placement has proved the most reliable means and has been shown to improve nasal airflow substantially.[20] Grafts are placed between the dorsal septum and upper lateral cartilage. Proximally the grafts are placed underneath the bony dorsum. By increasing the angle between the upper lateral cartilage and dorsal septum, the internal valve is properly stented. In some instances, if the upper lateral cartilages have been preserved, upper lateral cartilage tension-spanning sutures or autospreader flaps can be used to reconstitute the dorsum.[24-27]

Role of Spreader Grafts in Secondary Rhinoplasty

- Restoration of symmetrical dorsal aesthetic lines
- Correction of dorsal deviation
- Enhancement of nasal length
- Maintenance of tip projection
- Control of tip rotation
- Reconstruction of the internal nasal valve

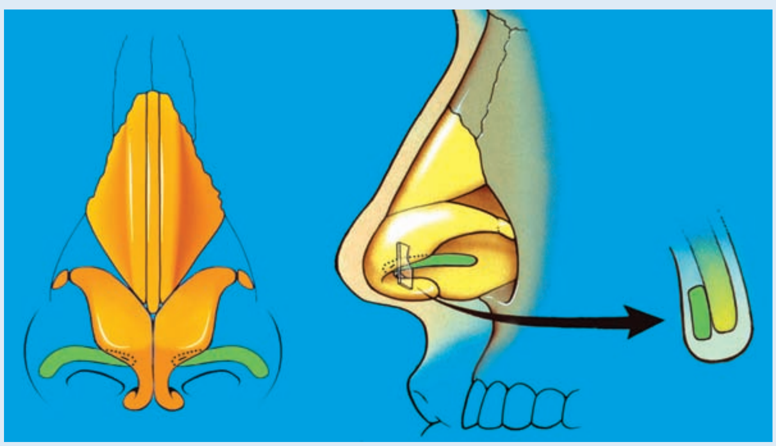
External valve function may be compromised by alar collapse or caudal septal deviation. If the strength and shape of the lateral crus is inadequate, we typically use alar contour grafts or extended alar contour grafts to provide additional support.[28]

Indications for and Contraindications to Alar Contour Grafts and Extended Alar Contour Grafts



Indications for the Alar Contour Graft

- Primary rhinoplasty patients with congenital alar rim notching
- Primary rhinoplasty patients with weak nasal alae/soft triangles with a propensity for notching
- Primary or secondary rhinoplasty patients with mild to moderate external nasal valve collapse
- Primary or secondary rhinoplasty patients with malpositioned lower lateral crural cartilages
- Secondary rhinoplasty patients with minimal vestibular lining loss and at least 3 mm of residual lower lateral cartilage alar rim strips



Indications for the Extended Alar Contour Graft

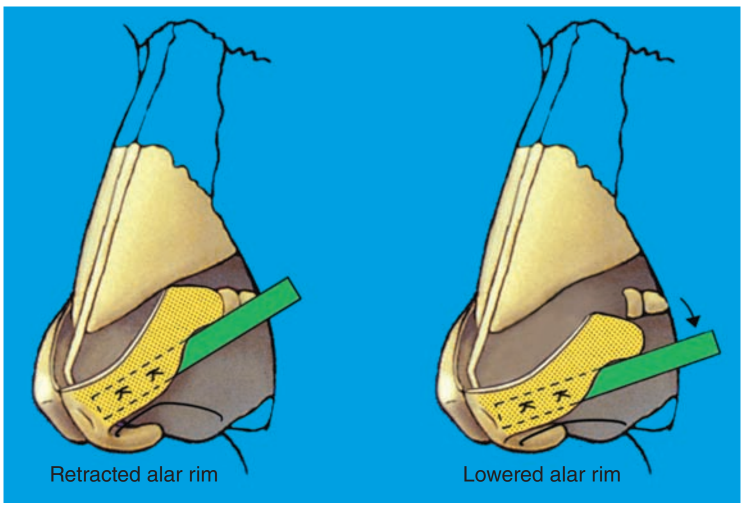
- The same indications as for alar contour grafts when more support of the alar rim is required
- Extended alar contour grafts to help control the rotational orientation of the lateral crus so that the caudal and cephalic borders are in the same horizontal plane

- Primary or secondary rhinoplasty patients with preexisting notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the piriform aperture

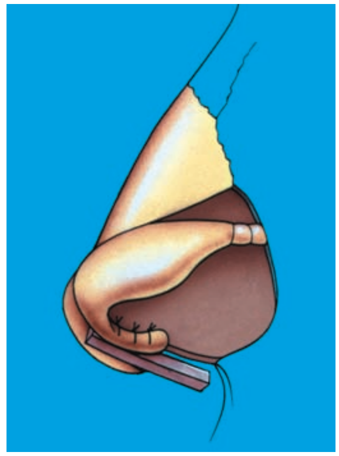
Contraindications to the Alar Contour Graft and Extended Alar Contour Graft

- Patients with significant vestibular lining loss as the cause of alar retraction
- Severe alar scarring (for example, burn patients)
- No lower lateral cartilage remnant (patients are better served with a lateral crural strut graft)
- Severe external nasal valve collapse

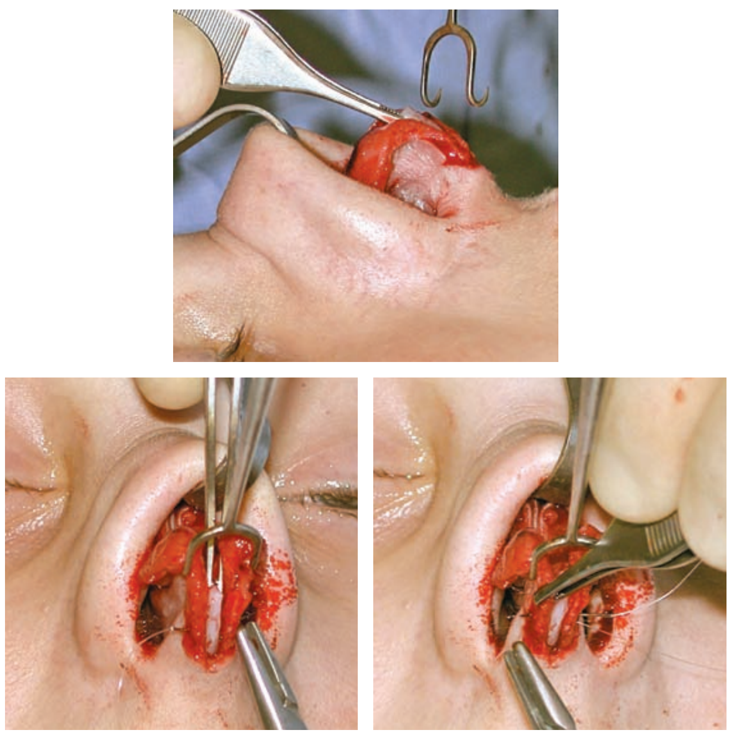
Nasal Tip



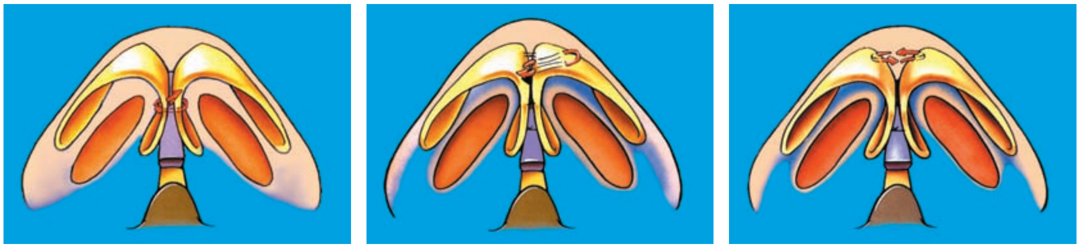
Malposition and destruction of the lower lateral cartilages are the most common issues addressed in secondary tip surgery. Overresection of the lateral crus leads to both aesthetic and functional problems. The tip may appear pinched, and the overall harmony of the lower third of the nose is distorted. Additionally, alar notching, retraction, or external valve collapse may accompany tip deformities. Reconstruction of the lateral crus with cartilage should be performed when indicated. Alar spreader grafts[29] can be used to address pinching, but many lateral crural deformities require lateral crural strut grafts to fortify the lateral crura and correct cartilage orientation.[30] The grafts are placed deep to the lateral crus and extend laterally just caudal to the alar groove.

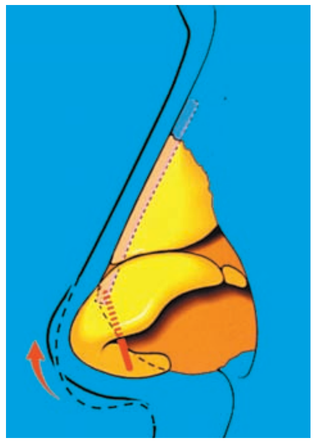


If the middle crura and caudal septum do not provide adequate tip support, a columellar strut graft[31-34] or septal extension graft[35] may be required to achieve appropriate tip projection and rotation. Placement of a columellar strut graft should be strongly considered to maintain tip support. Septal or costal cartilage is more suited for this graft, given their rigidity.



The columellar strut graft is placed between the medial crura, maintaining a soft tissue interface between the graft and underlying anterior nasal spine. Failure to maintain this soft tissue can lead to clicking as the graft slides back and forth over the bone.

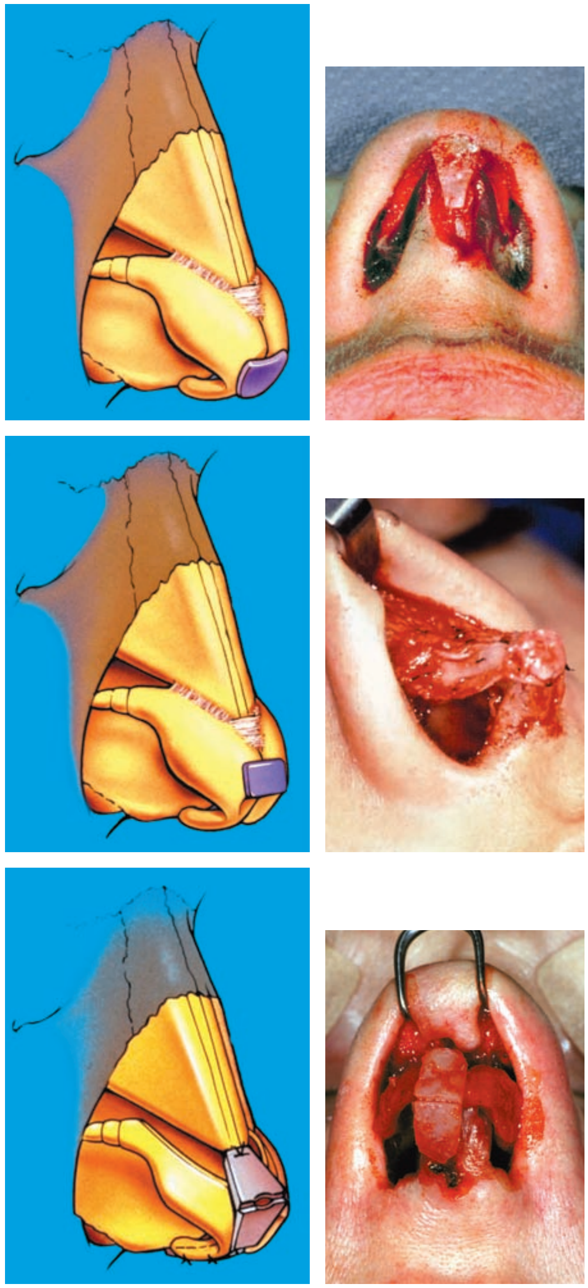




Tip definition and refinement requires an algorithmic approach to suture placement in the same manner as primary rhinoplasty. Commonly applied suture techniques, including medial crural sutures, medial crural–columellar strut sutures, transdomal sutures, interdomal sutures, and medial crural septal sutures.[35-38]

Graduated Approach to Tip Suturing

1. Medial crural–columellar strut sutures: Placed to stabilize the columellar strut graft between or in front of the medial crura.
2. Interdomal suture: Placed to increase infratip-columellar projection and definition. May also provide minimal increase in tip projection.
3. Transdomal sutures: Control dome symmetry and tip definition.
4. Medial crural septal sutures: Placed to alter tip projection or rotation.



When tip projection, definition, or symmetry is unobtainable with suture techniques, visible tip grafts are used. These grafts include onlay, infratip, and combination grafts.[35-38]

Secondary rhinoplasty patients may have insufficient lower lateral cartilages from prior resection. Weakening or loss of the middle crura of the lower lateral cartilages will necessitate either reconstruction of the domes or placement of tip grafts to reestablish tip shape. Tip grafts are more commonly employed in secondary cases than in primary rhinoplasty for this very reason.

Spreader grafts and tip grafts are more commonly used in secondary rhinoplasty than in primary rhinoplasty.

Patients with poor alar-columellar relationships require focus on this region. Treatment of a hanging columella typically requires resection of caudal septum or removal of a previously malpositioned columellar strut graft. If a columellar strut graft is placed in these patients, it must not reproduce the deformity. If the columella is retracted, a septal extension graft may be required to correct this problem.[39]

When altering tip projection, the surgeon must consider the quality and compliance of the skin and soft tissue envelope to prevent wound-healing problems or vascular compromise.

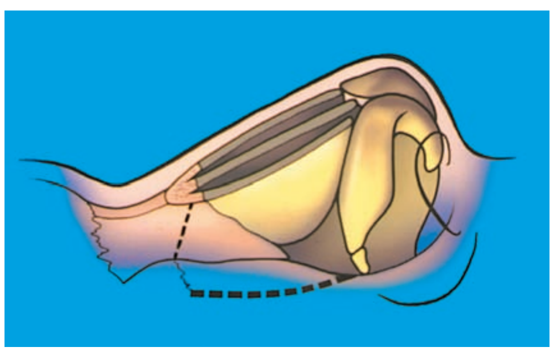
When altering tip projection, the surgeon must consider the quality and compliance of the skin and soft tissue envelope to prevent wound-healing problems or vascular compromise.

Nasal Ala

Alar notching or retraction is often alleviated with placement of the alar contour grafts. These grafts may also be used to correct asymmetry of the lateral nostril and strengthen the external valve.

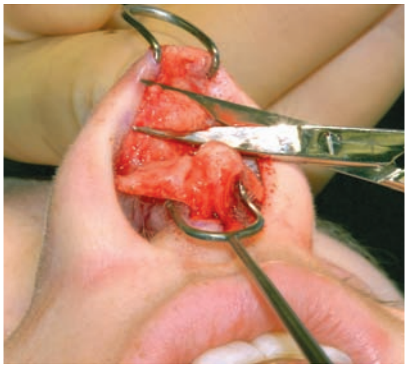
Alar contour grafts can improve alar notching and retraction in secondary rhinoplasty. The grafts improve nostril support and shape when properly used.

Osteotomies



If there is deviation of the bony vault, a wide upper dorsum, or an open roof following dorsal reduction, osteotomies should be performed.[40-42] Percutaneous perforated lateral osteotomies are used to fracture the lateral nasal bone. Low-to-low osteotomies are typically used and are continued into superior oblique osteotomies at the level of the medial canthi. Medial osteotomies are less frequently required but may be necessary to allow mobilization of the nasal bones in the absence of an open roof.

Closure



Before closure, all debris is carefully removed by irrigation with a bulb syringe of normal saline solution. The osteocartilaginous contour should be inspected for a smooth, harmonious appearance. Any residual scar tissue should be excised to improve definition and prevent irregular contours. In some instances, it may be necessary to excise scar tissue from the deep surface of the skin and soft tissue envelope.

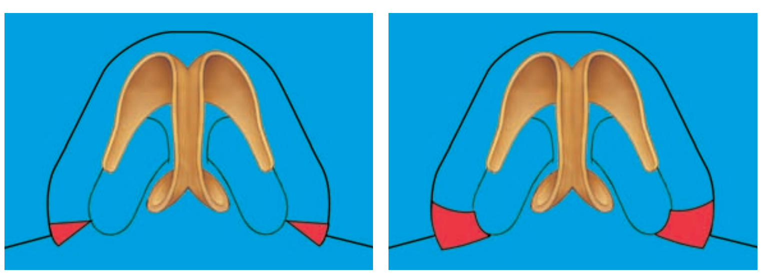
A final three-point test of the dorsal contour is performed, and any irregularities or depressions that are found are corrected with morselized cartilage onlay grafts. The soft tissue envelope is redraped and the supratip break is reassessed. The incision must be meticulously approximated to optimize wound healing and improve scar imperceptibility.

Alar Base Surgery

Alar base surgery may be required to achieve balance between the nasal tip and alar base. Addressing nasal base width is best accomplished following closure of the skin envelope.

Indications for Alar Base Modifications

- Nostril flaring
- Elongated nasal sidewalls
- Widened nasal base
- Large ala
- Alar asymmetry



In the presence of alar flaring with normal nostril size, excision is limited to tissue of the alar flare; nostril circumference is not altered. When alar flare is associated with abnormal or asymmetrical nostril size or shape the excision extends into the vestibule. Customization of the excision tailors to the deformity being addressed.

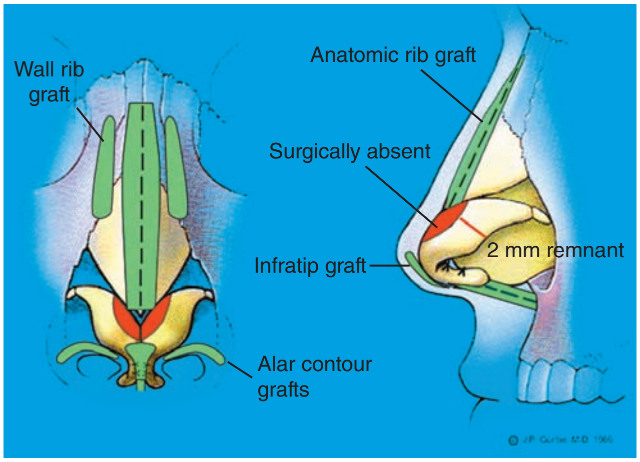
CASE ANALYSES

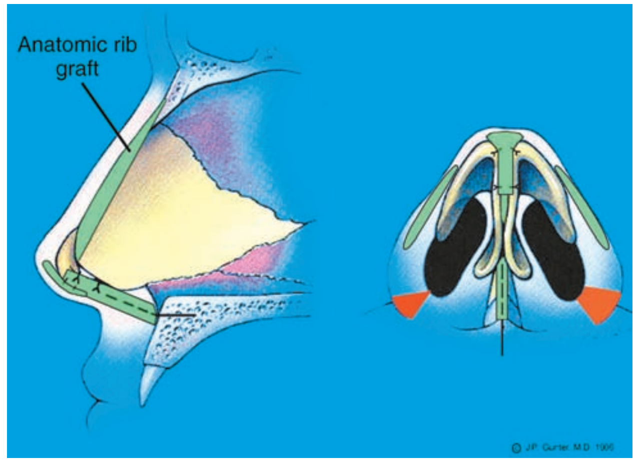
This 65-year-old woman had two prior rhinoplasties; a silicone implant was placed on the dorsum in the more recent one. She presented because of a nasal deviation, a displaced, mobile dorsal implant, and an inability to breathe nasally. The frontal view revealed moderately thick skin, an aging face, and a long middle third of the face. She had a right nasal deviation, ill-defined tip, and retracted columella. The dorsal aesthetic lines were disrupted at the keystone area. On lateral view, she had a low radix and a nasolabial angle of about 75 degrees. The basal view revealed inadequate tip projection and columellar-lobular imbalance, with retracted external nares and alar notching (right greater than left). She had alar base asymmetry and a loss of the teardrop appearance of the external nares as the result of previous nostril sill excision.

Internal nasal examination revealed normal septal mucosa with no evidence of inferior turbinate hypertrophy but moderate synechial formation of the internal nasal valve areas. Only a remnant of the septum was present. There was a large posterior septal perforation that did not have any significant crusting or bleeding. This perforation did not interfere with the nasal airway and was asymptomatic.

The operative goals included the following:

- Remove the silicone implant.
- Augment the dorsum.
- Increase tip projection/definition.
- Correct alar notching (right nostril more than left nostril).
- Improve the nasal airway by correcting internal/external valve stenosis.





Surgical Plan

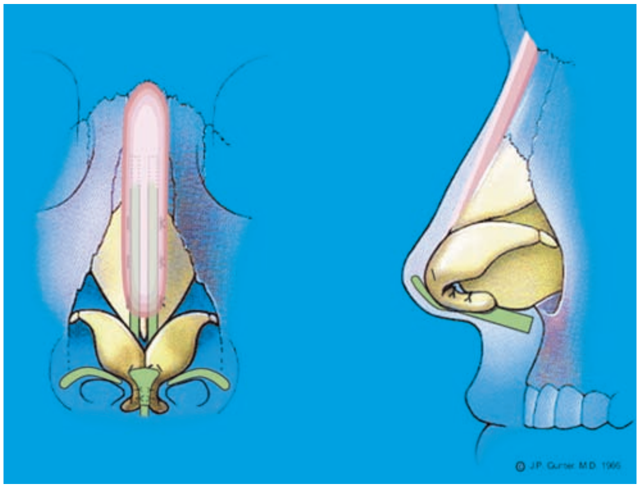
1. Use the open approach with a stair-step transcolumellar incision and infracartilaginous extensions.
2. Inject hydroxyapatite mixture (hydroxyapatite granules mixed with equal amounts of Avitene and autologous blood) into the perialar bases (1.5 ml into each small subperiosteal pocket).
3. Expose the nasal framework for a contoured rib cartilage graft.
4. Separate the remnants of the upper lateral cartilages from the septum to reconstruct the internal nasal valves in preparation for a dorsal onlay graft.
5. Perform partial anterior resection of the left inferior turbinate.
6. Harvest autogenous rib cartilage grafts from ribs seven and eight.
7. Perform suture fixation of the columellar strut graft at the medial crura and interdomal area to reestablish tip projection, and infratip-lobular suture fixation to reestablish infratip projection.
8. Contour and secure the shield graft at the infratip-lobular area.
9. Perform anatomic contouring of the columellar strut graft and dorsal onlay graft using balanced cross-sectional carving to minimize warping.
10. Secure anatomically contoured dorsal rib cartilage graft with 5-0 PDS sutures in the keystone area and anterior septal angle over remnants of the upper lateral cartilages. (This acts as a functional spreader graft in this area by increasing the space between the dissected, scarred upper lateral cartilages and septal remnants.)
11. Place alar contour grafts bilaterally into pockets below the infracartilaginous incision to correct alar notching.

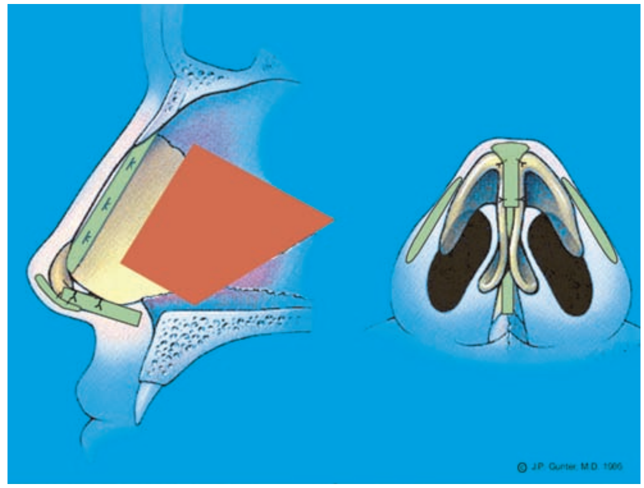
The patient result is shown 2½ years postoperatively. The transcolumellar incision is well healed and the dorsal lines are improved. Facial balance has been improved by the restoration of a straight nasal dorsum and correction of the nasal deviation and perialar deficiency. The nasal length has been increased with correction of the low radix. Nasal tip projection has been increased, the alar-columellar relationship has been improved, and the nasolabial angle is now 90 degrees. Comparison of the basal views demonstrates improvement in the alar-columellar relationship and alar notching; the external nasal valve configuration is also better.

This patient had one previous rhinoplasty and sought correction of a pinched appearing nose with asymmetry of the tip and deviation of the nose to the left. The frontal view demonstrated that she had a Fitzpatrick type II skin that was thin at the dorsum and tip. Her facial proportions revealed slight vertical maxillary excess and a decreased lower facial height. The nasal tip deviated slightly to the left with a collapsed midvault that resulted from collapsed upper lateral cartilages, causing narrowing of the internal nasal valve angle. Her dorsal aesthetic lines were narrow with a narrow bony base, giving the appearance of a pinched nose. The lateral and oblique views revealed a slightly shallow nasofrontal angle, increased nasal tip projection, and an increased columellar-labial angle. The basal view was dramatic, depicting bilaterally collapsed external nasal valves; the right side was worse, with alar notching at the level of the tip. Nasal tip asymmetry was seen at the basal view with slight deviation of the nose to the left.

The operative goals included the following:

- Correct the midvault collapse and nasal airway obstruction.
- Improve (widen) dorsal aesthetic lines.
- Correct external nasal valve collapse.
- Correct nasal tip asymmetry and decrease tip projection.





Surgical Plan

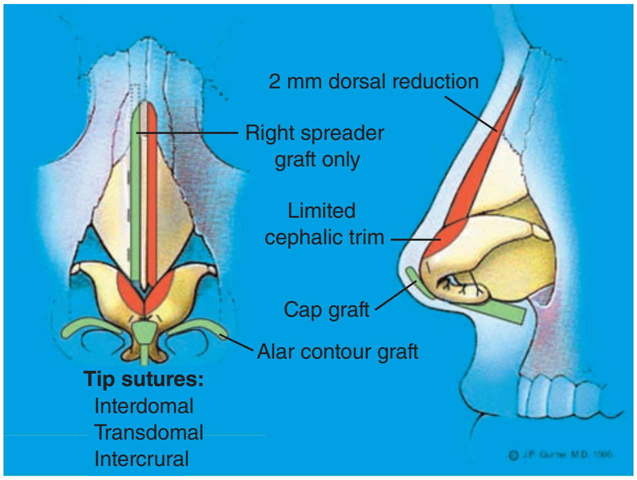
1. Use an open approach with a stair-step transcolumellar incision and infracartilaginous extensions.
2. Perform sharp exposure of the nasal framework and dorsum.
3. Separate the collapsed upper lateral cartilages from the mucosa and expose the nasal septal cartilage.
4. Harvest nasal septal cartilage.
5. Perform minimal dorsal rasping and smoothing.
6. Widen the dorsal aesthetic lines and improve the internal nasal valve angle by placing bilateral spreader grafts with the superior ends wedged under the nasal bones, and secure the spreader grafts with 5-0 PDS mattress sutures.
7. Place two layers of acellular dermal matrix for dorsal contour correction.
8. Place a columellar strut graft and secure it with 5-0 PDS medial crural-columellar strut sutures.
9. Refine the tip with interdomal and transdomal sutures and place a tip cartilage graft.
10. Place bilateral alar contour grafts, developing subcutaneous pockets at the level of the nasal vestibules.

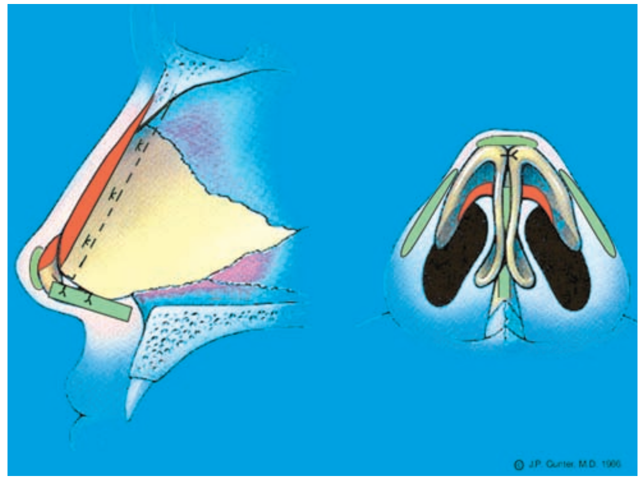
The postsurgical final result is shown. Analysis of the preoperative and postoperative frontal views reveals smoother, wider, and more refined dorsal aesthetic lines, with widening of the midvault. The nasal tip is more balanced and has smoother tip-defining points. The lateral preoperative and postoperative views confirm reduction of tip projection with a smooth dorsum and decreased columellar show. The oblique view confirms the improved nasal dorsum balance and restored dorsal aesthetic lines. On basal view it can be seen that the collapse of the external nasal valves has been corrected, with straightening of the columella. The transcolumellar scar is nearly imperceptible.

This patient presented for secondary rhinoplasty to correct her deviated nose and ill-defined nasal tip. She has Fitzpatrick type II skin. As seen on frontal view, she had adequate facial proportions and a deviated nose to the left with asymmetrical dorsal aesthetic lines. Her nasal skin is thin, revealing a distorted and deviated nasal tip with contour irregularities. The lateral view demonstrates a shallow nasofrontal angle leading to a slight dorsal hump and supratip notching. The columellar-lobular angle is increased (obtuse), with an abnormal alar-columellar relationship. Alar notching is present on the lateral view with flaring. The basal and overhead views show the dramatic asymmetry and distortion of the nasal tip framework with dorsal nose deviation. The nostrils are asymmetrical with grooving of the columella.

The operative goals included the following:

- Correction of the deviated nose.
- Correction of slight dorsal hump.
- Restoring nasal tip framework and symmetry.
- Correction of collapsed external nasal valves.





Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and infracartilaginous extensions.
2. Expose the distorted nasal framework and defining anatomy.
3. Separate the upper lateral cartilage from the septum proper.
4. Expose the nasal septum and harvest septal cartilage.
5. Component dorsal hump reduction (2 mm cartilage and bony reduction performed incrementally)
6. Secure a right spreader graft to the dorsal septum with 5-0 PDS to straighten the deviated nose.
7. Perform limited cephalic trim of the lower lateral cartilages, sparing the intermediate crus.
8. Secure a columellar strut graft with 5-0 PDS medial crural–columellar strut sutures.
9. Refine the tip with interdomal and transdomal sutures and place a cap graft from the cephalic trim.
10. Place alar contour grafts subcutaneously at the nasal vestibule to correct for the weak and collapsed external nasal valves.

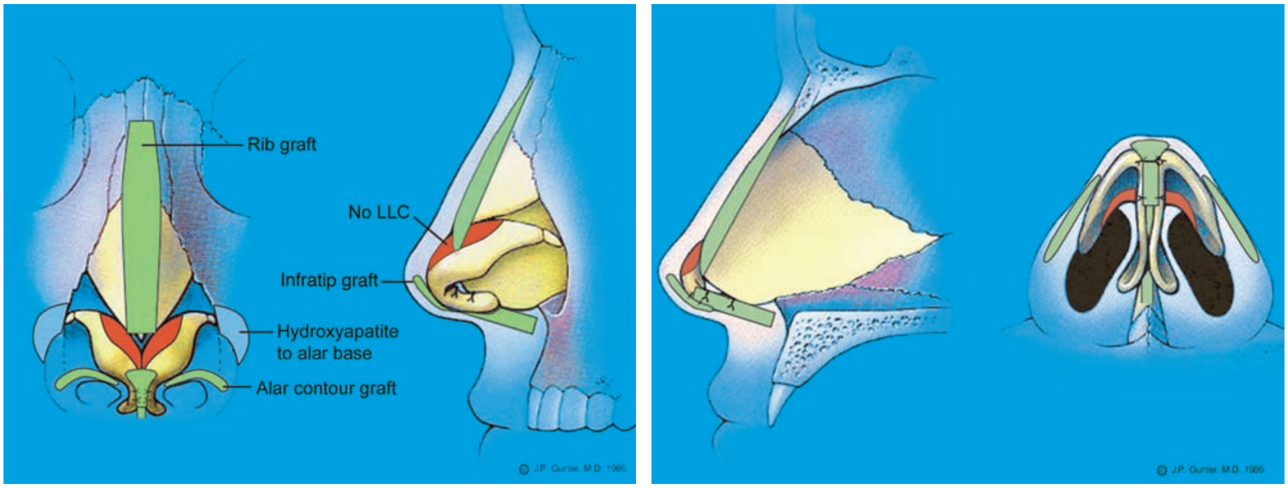
The patient is shown 1 year postoperatively with a straight nose, improved dorsal aesthetic lines, and a balanced nasal tip as seen from the frontal view. The lateral view reveals a smoother nasal dorsum with an improved nasolabial angle and alar-columellar relationship.

The basal and overhead views demonstrate restoration of a symmetrical nasal framework with a straight columella and absence of grooving. Despite her thin nasal skin flap, contour irregularities have been corrected with smoother tip-defining points. The overhead view shows natural dorsal aesthetic lines with correction of alar notching.

This patient presented after undergoing two previous rhinoplasties and requested correction of her short, overresected nose. Her frontal view showed Fitzpatrick type II skin with moderate sun damage. Her facial proportions revealed a long face caused by vertical maxillary excess. Her tip-defining points were asymmetrical, with a slight deviation of the nasal tip. The lateral view demonstrated a short nose with a slight dorsal hump, a lack of a supratip break, and an increased (obtuse) columellar-lobular angle. She also had an increased columellar-labial angle of more than 100 degrees with increased nostril show. The oblique view confirmed the underprojected short nose with an obtuse columellar-lobular angle and an undefined nasal tip. The basal view showed a narrow alar base, slightly collapsed and weak external nasal valves, and a deviated septum with slight deviation of the nasal tip to the left.

The operative goals included the following:

- Lengthen the short nose.
- Correct the dorsally deviated nose.
- Correct the narrow and pinched alar bases.
- Correct the collapsed external nasal valves.
- Refine the deviated and underprojected nasal tip.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and infracartilaginous extensions.
2. Perform sharp, careful exposure of the nasal framework, revealing overresection of lower lateral cartilages with no remnant of original anatomy of the external nasal valves.
3. Separate the upper lateral cartilages from the septum proper.
4. Perform minimal dorsal hump reduction by rasping, and prepare an onlay rib graft.
5. Harvest a ninth rib graft for dorsal augmentation and lengthening of the short nose.
6. Secure the rib graft with 5-0 PDS sutures to the dorsal nasal septum.
7. Inject hydroxyapatite to bilateral alar bases to widen the narrow alar base and camouflage the sharp alar-cheek groove.
8. Secure a columellar strut graft (harvested from the rib) with 5-0 PDS medial crural–columellar strut sutures.
9. Refinement with interdomal and transdomal sutures and placement of infratip lobular graft.
10. Place bilateral alar contour grafts in the subcutaneous pockets of the nasal vestibule to correct the weak external nasal valves.

The patient is shown 1 year postoperatively. The result demonstrates symmetrical dorsal aesthetic lines on the frontal view with balanced tip-defining points and correction of the nasal deviation. The narrow alar bases have been slightly widened to restore symmetry. The lateral view of the nasal dorsum shows correction of the short nose with adequate lengthening. The natural alar-columellar relationship has been restored, with correction of increased nostril show. The columellar-labial and columellar-lobular angles both have been restored and decreased to achieve a more natural 95-degree nasolabial angle. The basal view shows symmetrical nostrils and an improved nasal dorsal and tip balance, a straight columella, and an aesthetically pleasing triangular nasal tip.

CONCLUSION

Secondary rhinoplasty is a challenging operation complicated by existing scar formation, depleted cartilage stores, and weakened nasal structures. Communication between the surgeon and patient is crucial in exploring what is achievable and setting realistic expectations. The open approach allows for maximal exposure and a more comprehensive assessment of the underlying problems. Moreover, the open approach allows controlled and precise execution of the surgical plan resulting in consistent outcomes.

KEY POINTS

- Secondary rhinoplasty is often complicated by alteration of the native anatomy, typically involving weakened or missing supportive structures, the presence of scar and loss of soft tissue elasticity, and depleted cartilage stores.
- The open approach for secondary rhinoplasty allows maximal exposure, aiding in diagnosis and treatment.
- Communication between the surgeon and patient in exploring what is achievable and setting realistic expectations is of paramount importance. One should avoid operating on patients with unrealistic expectations or who are emotionally unsuitable for secondary rhinoplasty.
- Comprehensive systematic nasal analysis facilitates identification of nasofacial disproportions and imbalances and helps to establish the goals for rhinoplasty surgery.
- Evaluation of the secondary rhinoplasty patient requires comprehensive external nasal analysis and internal nasal examination. Potential cartilage donor sites such as the septum, ear, and rib should also be examined.
- Computer imaging provides an opportunity for the surgeon to assess the patient's level of expectations and whether they are realistic for secondary rhinoplasty surgery.
- Opening the nose in secondary rhinoplasty should be performed in a meticulous manner as scar obliterates natural tissue planes.
- It is common to find a layer of scar tissue covering the cartilaginous framework, and this should be sharply excised to expose the cartilages; this will also facilitate contour and definition.
- The component approach to the nasal dorsum optimizes preservation of cartilage and mucosa preventing external deformities of the midvault and dysfunction of the internal nasal valves.
- Spreader grafts and tip grafts are more commonly used in secondary rhinoplasty than in primary rhinoplasty.

- When altering tip projection, the quality and compliance of the skin and soft tissue envelope must be considered to prevent wound-healing problems or vascular compromise.
- Alar contour grafts can improve alar notching and retraction in secondary rhinoplasty. The grafts improve nostril support and shape when properly used.

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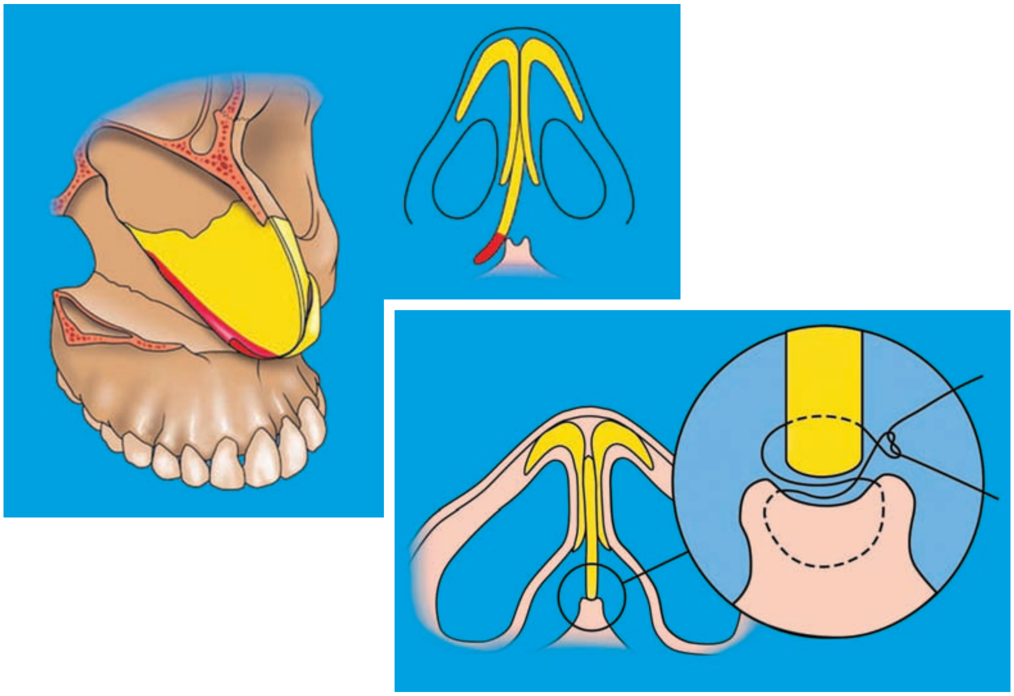
PART NINE

Management of Airway Dysfunction



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Surgical Management of the Nasal Airway

Jamil Ahmad ▪ Rod J. Rohrich ▪ Michael R. Lee

Comprehensive surgical management of the rhinoplasty patient should address both aesthetic and functional concerns.[1] Nasal airway obstruction is common in patients presenting for rhinoplasty. In some cases, they have structural problems that contribute to poor nasal airflow; however, they have often been told that their symptoms are the result of other problems, such as allergies or sinusitis. In many instances patients are unaware that they have a problem with breathing through their nose.

Management of the nasal airway requires knowledge of the external and internal nasal anatomy and physiology of the nose and nasal cavity.[1,2] Application of this knowledge guides clinical diagnosis, medical treatment, and surgical planning. Furthermore, it facilitates optimal outcomes with appropriate surgical treatment and prevents iatrogenic nasal dysfunction following rhinoplasty.

CAUSES OF NASAL AIRWAY OBSTRUCTION

Nasal airway obstruction may be present in up to a third of adults. It may be the result from anatomic and/or physiological etiologic factors.

Etiologic Factors in Nasal Airway Obstruction

Anatomic	**Physiologic**
Nasal septum	Infectious rhinitis
Internal nasal valve	Allergic rhinitis
External nasal valve	Vasomotor rhinitis
Inferior turbinates	Atrophic rhinitis
Polyps	Rhinitis medicamentosa
Concha bullosa	Postoperative rhinitis
Neoplastic	Hypertrophic rhinitis
Congenital	
Iatrogenic	

Nasal physiology is discussed in Chapter 3, and medical management of rhinologic disorders is discussed in Chapter 4. Anatomic causes of nasal airway obstruction that are commonly addressed during rhinoplasty are the focus of this chapter. The key structures causing nasal airway obstruction include the:

- Nasal septum
- External nasal valve
- Internal nasal valve
- Inferior turbinates

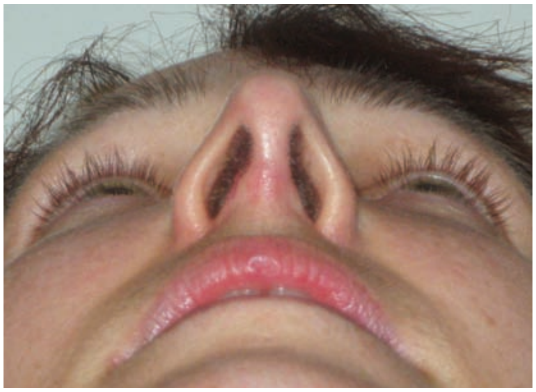
CLINICAL EVALUATION

Primary assessment of the nasal airway is accomplished through a focused history and physical examination.

History

Patients presenting for rhinoplasty may complain of difficulty breathing through their nose, stuffiness, or congestion. However, in many instances patients are unaware that they have problems breathing through their nose. Relevant factors include the onset, timing, duration, and severity of symptoms. Exacerbating and alleviating factors should also be detailed. Prior trauma or nasal surgery should be ascertained. Nasal airway obstruction that is constant suggests an anatomic problem, whereas fluctuating symptoms are more commonly associated with a physiological cause. Symptoms of unilaterality, epistaxis, or a progressive worsening warrant exclusion of a neoplasm.

Physical Examination



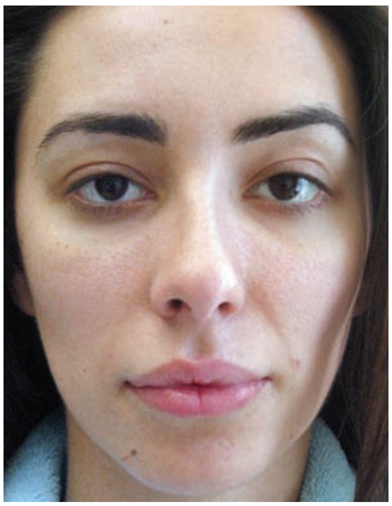
Normal inspiration

Forced inspiration

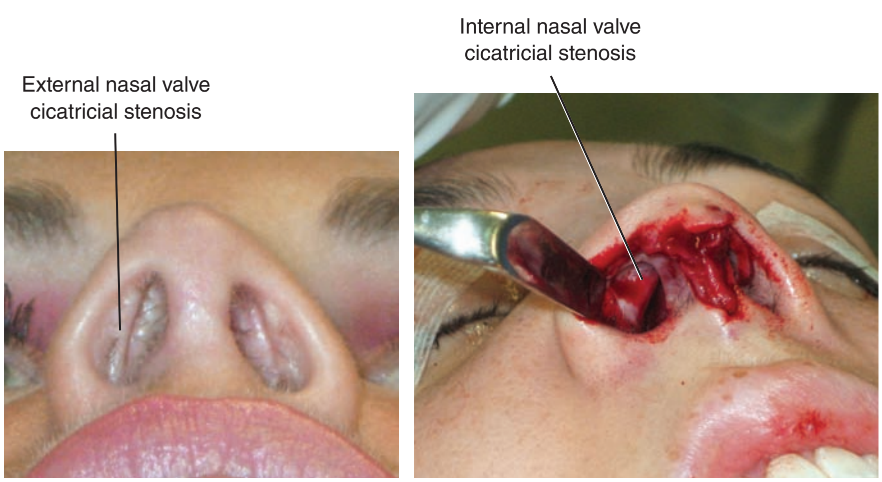
Physical examination should begin with evaluation of the external nose. The external nasal valve can be assessed by observing the nasal base during quiet and forced inspiration. Although the support of the alar rim may be adequate to withstand the forces generated during quiet inspiration, dynamic alar rim collapse may occur during deep or forced inspiration.

Collapse of the nostril, which may be unilateral or bilateral, suggests a weak lateral crus. Similarly, collapse of the lateral nasal wall may suggest weak upper lateral cartilage and possibly internal valve dysfunction.

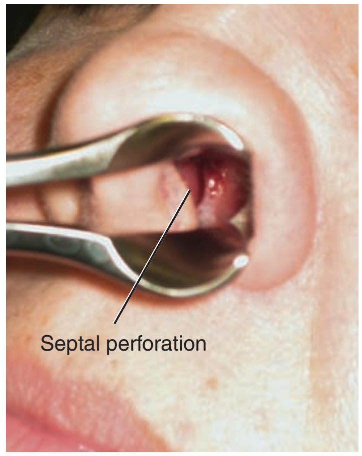
Dorsal nasal deviation or collapse suggests a septal cause, with the potential for internal valve dysfunction.



Collapse of the nasal midvault may be seen in patients displaying an inverted-V deformity or distorted dorsal aesthetic lines.



Prior nasal surgery may create cicatricial stenosis of the external or internal nasal valves.



Internal examination of the nose is of critical importance and is facilitated with a nasal speculum and proper lighting. The nasal cavity should be assessed at rest and during respiration. At rest, the septum can be assessed. Deviation, septal spurs, or perforation of the septum should be noted. Crusting or dried blood may be a sign of underlying pathology.

Turbinate status should also be investigated. Large boggy turbinates with a bluish hue suggest allergic changes to the mucosa. Application of a topical nasal decongestant such as oxymetazoline can help distinguish between mucosal swelling and bony hypertrophy. If the turbinate responds with resolution of engorgement, then mucosal disease is the primary problem. Mucosal disease is less responsive to surgical intervention compared with bony hypertrophy or malposition. Middle turbinates should also be assessed for the existence of concha bullosa.

The internal nasal valve is evaluated both at rest and during respiration. The caudal border of the upper lateral cartilage can usually be seen as it adjoins the nasal septum. Collapse of the internal nasal valve suggests dysfunction.

Nasal airway obstruction is diagnosed from both history and physical examination and will guide surgical treatment planning.

Investigations

Although the history and examination often provides the appropriate diagnosis, in some cases it may be beneficial to obtain objective data through additional investigations. These may provide more information that can be used to support clinical findings or may be useful to objectively evaluate changes in nasal airflow

following surgery. However, the results of these tests should always be correlated with the clinical findings to confirm the clinical significance, validity, and reproducibility of these tests.[2-9]

Rhinomanometry

Rhinomanometry provides objective data regarding nasal pressure and airflow. Results can be obtained from either active or passive means of airflow. For active rhinomanometry the patient breathes through one nostril while data regarding pressure differential are obtained from the contralateral side. Passive rhinomanometry includes measurement of both nasal sides with a given airflow. The pressure differential is measured from the anterior airway (by a nozzle in the nares or a face mask) and the posterior airway (transorally). The nasal resistance is obtained by measuring the recorded pressures and airflow.

Acoustic Rhinometry

Acoustic rhinometry uses sound waves and their reflection from the nasal cavity to determine the subsequent cross-sectional area. The areas of minimal cross-section are noted both before and after nasal decongestion. Changes or alterations in the nasal mucosa alter the area-distance curve and provide information about the geometry of the nasal cavity and its response to treatment. Challenges with acoustic rhinometry are related to areas of airflow resistance that are not necessarily clinically relevant and variability of measurements based on instrument positioning.

Nasal Cytology

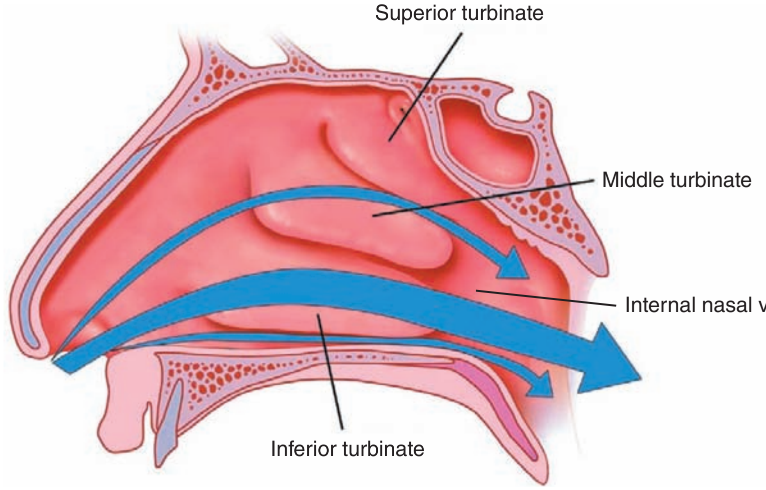
Analyzing nasal discharge in those patients suspected of having an allergic or infectious component may be helpful. Patients with allergic rhinitis or rhinosinusitis will frequently display high eosinophil concentrations, whereas an infectious process is more associated with polymorphonucleocytes.

Radiology

Plain film radiographs or CT scans may identify bony septal deviation or turbinate excess and should be reviewed when available. Although these may support the clinical diagnosis, they are not required as part of the routine workup for nasal airway obstruction. Air-fluid levels or sinus opacification may also be assessed and can suggest either an acute or chronic process. While a CT scan may be useful, MRI is associated with much lower specificity.

ANATOMY

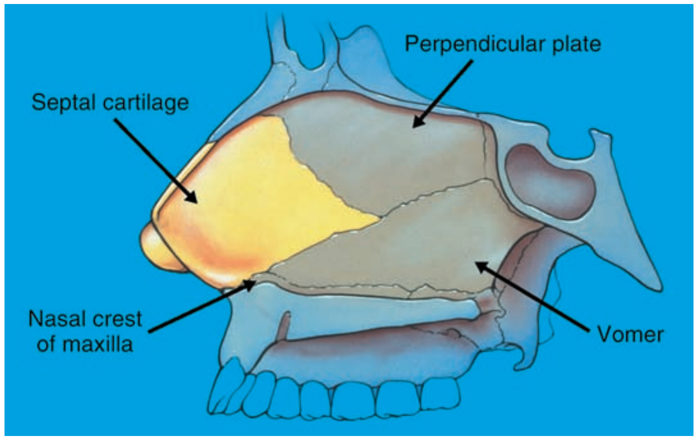
Nasal Airflow



External air is transported into and through the nasal cavity by a generated pressure differential.[1,2] The negative intranasal pressure generated during inspiration allows air movement and is influenced by the velocity of airflow and resistance along the nasal cavity. Initiation of inspiration is associated with nostril enlargement to accommodate the influx of external air into the nose and through the external nasal valve. Inspired air continues through the nasal cavity in a parabolic curve following this pressure gradient. The majority of air continues over the inferior turbinate, passing through the middle meatus; the greatest resistance occurs at the internal nasal valve.[1,2] Anterior and inferior deformities tend to be poorly tolerated, because the cross-sectional area of the nasal airway is small compared with the posterior area in the nasal cavity.

Anterior and inferior deformities tend to be poorly tolerated, the cross-sectional area of the nasal airway is small compared with the posterior area in the nasal cavity.

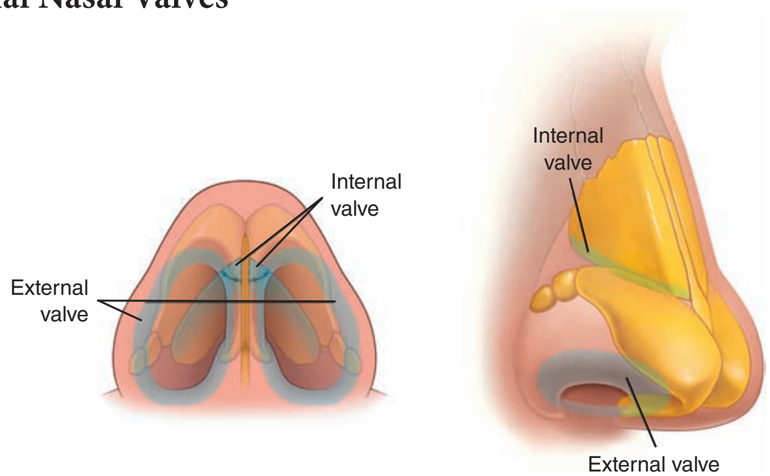
Nasal Septum



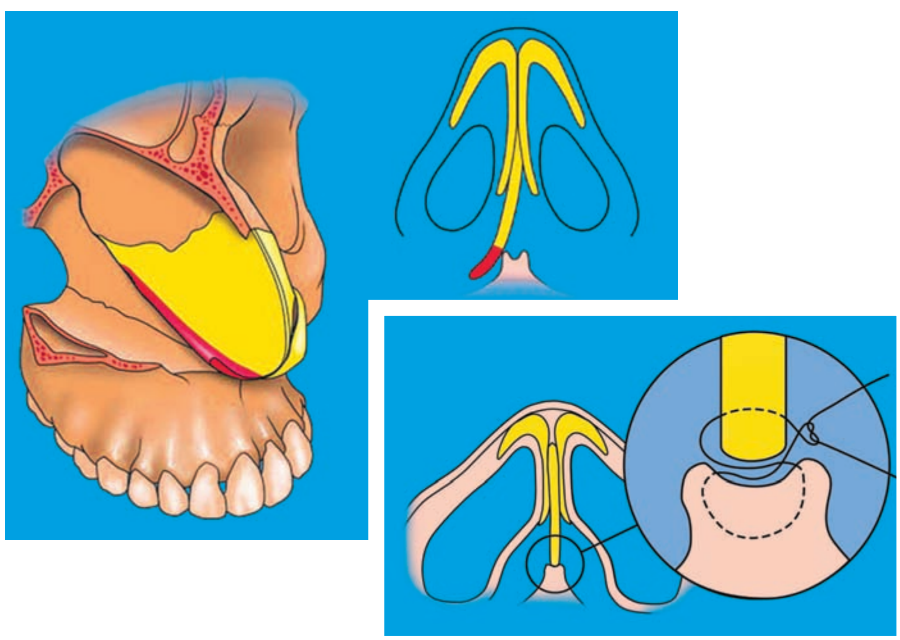
In addition to comprising the external and internal nasal valve, the septum may cause obstruction of airflow throughout the nasal cavity.[1,2,10-12] Although deviation of the anterior cartilaginous or posterior bony septum may lead to nasal airway obstruction, the anterior septum tends to be more clinically relevant because of the smaller cross-sectional area of the anterior airway. The cross-sectional area of the posterior airway is much greater in comparison with that of the nasal valves of the anterior airway. However, posterior deviations may still cause significant clinical symptoms.

Furthermore, the septum provides overall support for the external nose. Seated on the anterior nasal spine of the maxilla, the nasal septum serves as the scaffolding for mucosa and upper and lower lateral cartilages. Anomalies of the septum such as deviations, spurs, and perforations may adversely impact nasal airflow. These changes may be developmental in nature and worsen over time, or septal abnormalities may be posttraumatic. Deviation of the septum may also influence turbinate size and mucosal behavior. Typically the inferior turbinate on the side opposite of the septal deviation will undergo mucosal and/or bony hypertrophy.[1,2,10,11,13]

External Nasal Valves

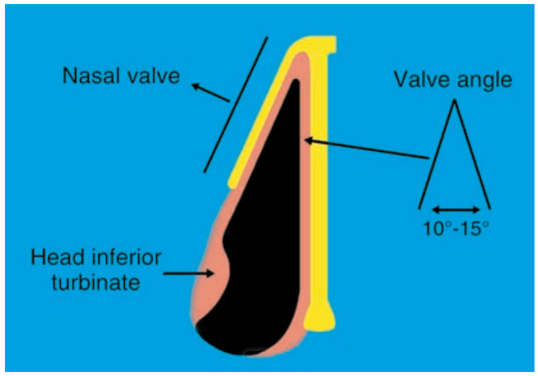


Nasal airflow begins with movement through the nostril and into the vestibule. The nasal vestibule houses the external nasal valve formed by the alar rim, nasal sill, caudal septum and medial crus.[1,2] A weakened or malpositioned lateral crus can lead to external valve collapse and subsequent obstruction. The external nasal valve is responsible for approximately a third of total airway resistance. In the presence of insufficient cartilaginous support, low pressures in the vestibule during inspiration can collapse the nostril and vestibule increasing resistance and decreasing flow. This is frequently seen in secondary rhinoplasty patients in whom the lateral crura have been overresected or weakened by manipulation.



Severe caudal septal deviation can contribute to decreasing the cross-sectional area of the external valve and contribute to obstruction at this site.[10-13]

Internal Nasal Valves

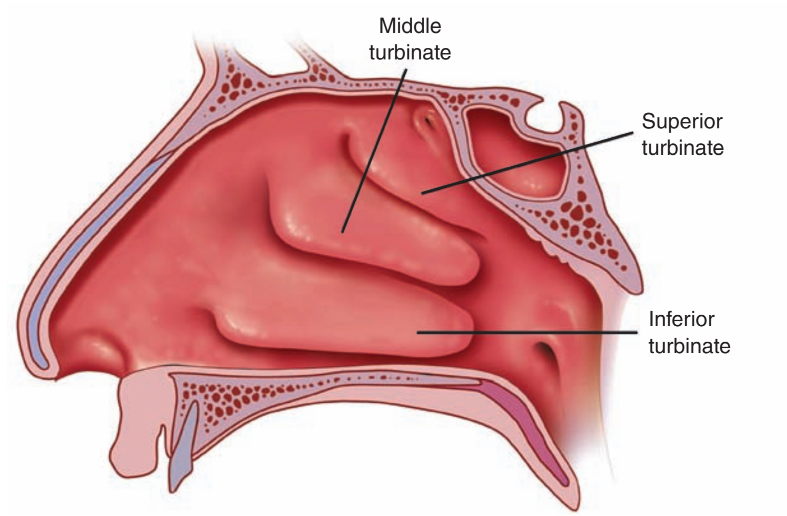


Resistance to nasal inflow is greatest at the internal nasal valve; it accounts for the majority of total airway resistance.[1,2] As previously mentioned, the abutment of the caudal edge of the upper lateral cartilage with the dorsal septum creates the internal valve angle. Airflow through the internal nasal valve may be limited when the angle formed by the junction of upper lateral cartilage and nasal septum is less than the typical 10 to 15 degrees. Additionally, the anterior head of the inferior turbinate forms the posterior border and hypertrophy will also negatively effect nasal airflow at the internal nasal valve.[14] When the inferior turbinates are a contributing factor, it must be determined whether bony hypertrophy or mucosal disease is the cause.

Airflow through the internal nasal valve may be limited when the angle formed by the junction of upper lateral cartilage and nasal septum is less than the typical 10 to 15 degrees.

Deviation of the dorsal septum can also compromise the internal nasal valve. This area must be addressed surgically to straighten the septum and restore the angle of the internal nasal valve. When the upper lateral cartilages lack the rigidity necessary to withstand inspiration pressure changes, there can be a dynamic collapse of the valve.

Inferior Turbinates



Nasal turbinates are paired extensions of the lateral nasal wall. They serve to increase overall mucosal surface area. Turbinates contribute a significant role in air transport and conditioning as well as olfaction.[1,2,15,16] The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve. However, the middle turbinates may also contribute to nasal airway obstruction.

The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve.

Inferior turbinate hypertrophy may be mucosal only or may also involve the underlying bone. Mucosal constriction will help to differentiate between the two. Inferior turbinate hypertrophy commonly accompanies septal deviation and is typically worse on the side contralateral to the side of septal deviation.

Inferior turbinate hypertrophy may be mucosal only or may also involve the underlying bone.

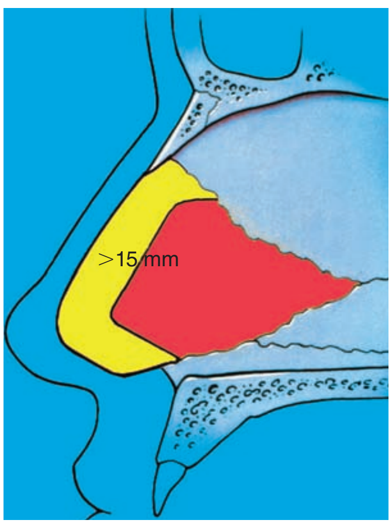
OPERATIVE TREATMENT

During rhinoplasty the nasal septum, external nasal valves, internal nasal valves, and/or the inferior turbinates may need to be surgically corrected. Both preoperative and intraoperative findings will guide treatment.

Nasal Septum

Surgical correction of the septum in general may be accomplished through septoplasty or septal reconstruction. Septal reconstruction involves midline repositioning of the septum or resection of deviated portions or spurs.[10-14]

Once the deviated septum has been widely exposed and separated from the upper lateral cartilages using a component approach to the dorsum, it must be straightened by addressing and correcting the intrinsic deforming forces. The goal is to straighten the septum while maximizing residual dorsal nasal support.



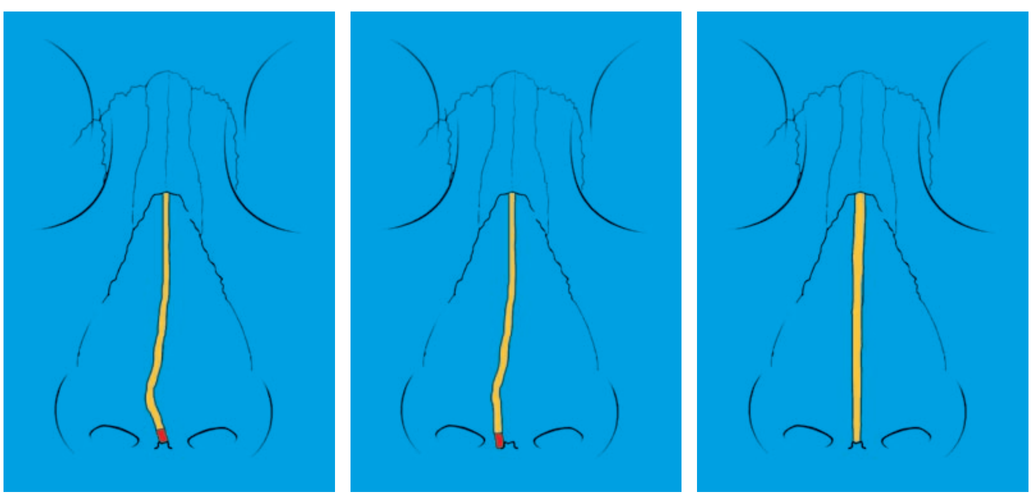
Initially the deviated portion should be resected, taking care to preserve at least 10 mm of an L-strut; this will depend on the strength of the septal cartilage, and in many instances a width of 15 mm or more may be required to ensure long-term support. The resection may include the septal cartilage, maxillary crest, vomer, and perpendicular plate of the ethmoid. The L-strut should remain attached to the perpendicular plate at the keystone area and the anterior nasal spine and maxillary crest area. In addition, curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut as well as between the dorsal and caudal L-strut can help to strengthen the construct.[11]

In many instances the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength.

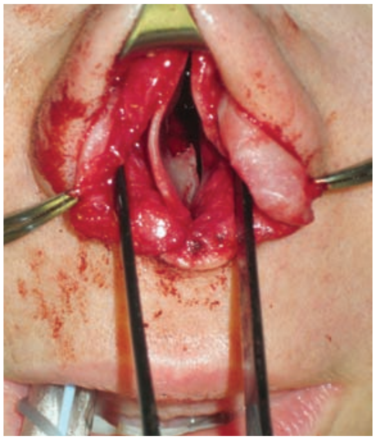
The anterior two thirds and the inferior aspect of the septum posteriorly can affect nasal airflow significantly when deviated from the midline.[1,2,10,11] Anterior and inferior septal deviations tend to be poorly tolerated, because the cross-sectional area of the nasal airway is small compared with the posterior area in the nasal cavity. Septal reconstruction involves returning the deviated septum to the midline. The principle of cartilage preservation is paramount. Cartilaginous septum that is deviated or required for grafting should be removed.

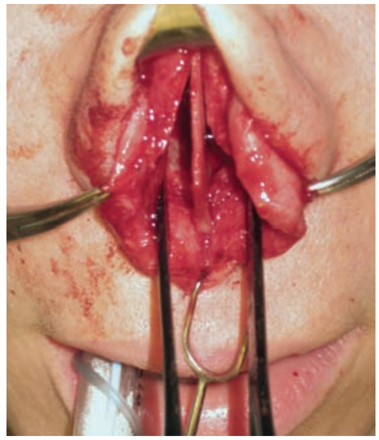
When addressing the bony septum, the septum can be microfractured and returned to the midline. In cases of C- or S-shaped craniocaudal deviation, there is vertical excess of the septum and removing the inferior aspect of the septum allows for microfracture of the remaining septum and return to the midline. Microfracture should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. This is particularly important in posttraumatic cases where there may have been a prior septal fracture. Bony spurs of the septum can be removed using Takahashi forceps. Septal cartilage or bone should be removed with ease, if there is any resistance, residual soft tissue attachments should be completely released.

Microfracture should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. Septal cartilage or bone should be removed with ease; if there is any resistance, residual soft tissue attachments should be completely released.



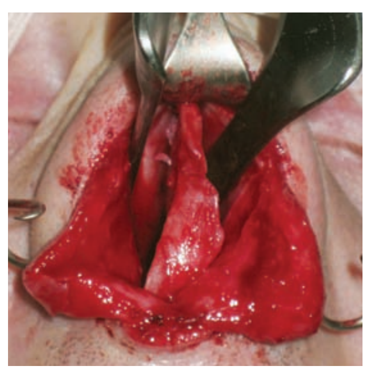
Once the posterior septum has been reconstructed, if there is a persistent caudal septal deviation, this is typically due to vertical excess of the anterior septum.





The caudal portion of the L-strut is disarticulated from the osteocartilaginous junction with the anterior nasal spine and maxillary crest. The degree of vertical excess is assessed and this is excised to allow the previously deviated septum to be returned to midline. A 5-0 PDS suture is used to suture the caudal septum down to the periosteum of the contralateral aspect of the anterior nasal spine. When the anterior nasal spine is located away from the midline, it may be necessary to perform an osteotomy to the anterior nasal spine to return it to the midline or excise the anterior nasal spine and suture the septum down to the periosteum of the maxilla. Excessive resection of the anterior nasal spine can damage the anterior maxillary nerve and subsequently cause some upper lip numbness.

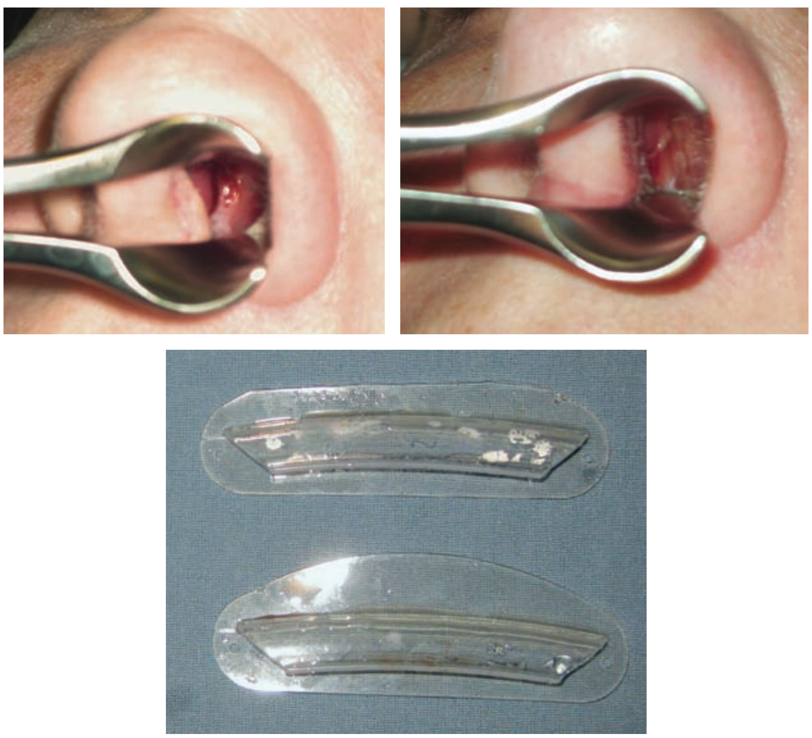
When extensive work has been done to the caudal septum, it is usually necessary to place several through-and-through horizontal mattress 5-0 chromic gut sutures in the caudal septum to reapproximate the caudal mucoperichondrial flaps to the midline. This allows the flaps to scar down in the midline position and provide extra long-term support.



Although these concepts and simplified approach to correction of caudal septal deviation have worked effectively in the majority of cases, in some instances, it is

necessary to be more aggressive in correcting severe deformities of the anterior septum. Scoring or partial thickness wedge excisions coupled with the application of splinting grafts may be required to establish a straight and stable L-strut. Similarly, deformities of the anterior septum stemming from previous fracture lines such as sharp angulations or overlapping segments, also require more complex maneuvers to first weaken or divide the anterior L-strut and then reinforce or reconstruct the L-strut into a straight construct.

Techniques such as swinging-door flaps, wedge excisions, splinting grafts, tongue-in-groove grafts, drill-hole fixation, and medial crural footplate excision may be necessary for adequate correction of severe caudal septal deviations.[10-14] These techniques may require more cartilage than is present in the septum, necessitating auricular or rib cartilage harvest.



On occasion, chronic septal perforations are present. Although they typically do not obstruct nasal airflow, they may cause problems ranging from a whistling sound during respiration to chronic bleeding, crusting and malodor. Repair of septal perforations may be achieved using local mucosal flaps or the placement of interposition grafts such as temporal fascia.

Following septal surgery, internal nasal splints are placed and secured with a through-and-through 3-0 nylon suture. The upper edge of the splints is typically trimmed so that removal will be easier postoperatively and they are coated, with antistaphylococcal antibiotic ointment. It is important to insert the internal nasal splints under direct visualization to prevent inadvertent dissection of the septal mucoperichondrial flaps and placement in the submucoperichondrial pocket. These splints maintain the septum in the midline, help avoid collapse of the upper lateral cartilages, and may help reduce the risk of postoperative septal hematoma or development of synechia.

It may take 3 to 4 months for the nasal airway to improve after septal surgery. After the splints are removed, saline nasal spray may be used to help remove mucus and debris from the nasal cavity to improve airflow. If symptomatic internal nasal edema persists longer than 1 month after surgery, a short course (2 weeks) of an intranasal corticosteroid spray such as fluticasone propionate may be beneficial.

External Nasal Valves

Management of the external nasal valve may include the following:

- Correction of caudal septal deviation
- Lateral crural turnover flaps
- Alar contour grafts
- Lateral crural strut grafts

Correcting deformities of the external nasal valve hinges on correcting the existing weakness of the lateral crus. If the lateral crus is weak, cartilage flaps and/or grafts such as lateral crural turnover flaps, alar contour grafts, lateral crural strut grafts, or alar batten grafts may be required.[17-19]

In addition to strengthening the lateral crus, midline repositioning of the caudal septum is of equal importance for reestablishing the structural integrity of the external nasal valve.

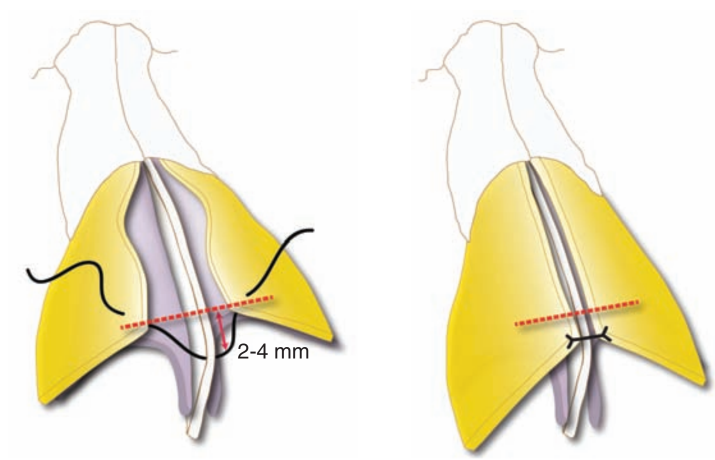
Internal Nasal Valves

Management of the internal nasal valve may include the following:

- Component approach to the dorsum
- Suture techniques
- Autospreader flaps
- Spreader grafts
- Dorsal spreader flap

Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty. Disruption may occur during dorsal hump reduction emphasizing the importance of maintaining or rebuilding the internal valve. Patients exhibiting short nasal bones and long, poorly supported upper lateral cartilages are at highest risk. We have evolved a component approach to the dorsum to prevent these undesirable problems.[20-22] It involves the following:

- Release of the upper lateral cartilages from the dorsal septum
- Resection of the dorsal septum incrementally
- Rasping of the bony dorsum
- Restoration of the dorsal aesthetic lines

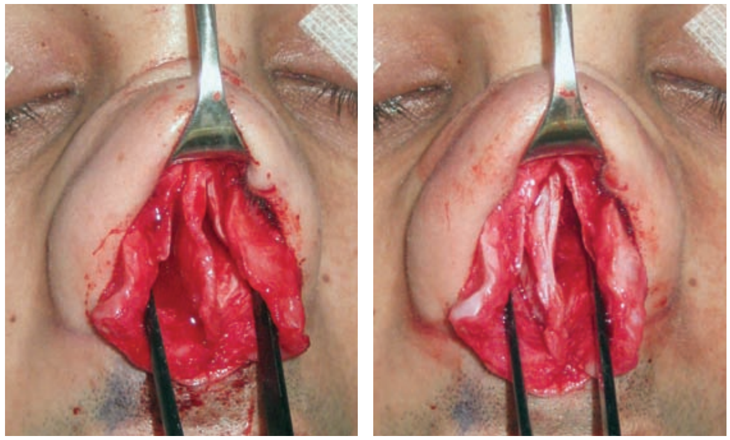


Preservation of the upper lateral cartilages allows for reconstitution of the midvault and restoration of the dorsal aesthetic lines and internal nasal valve. Upper lateral cartilage tension-spanning sutures are used to reconstitute the midvault.[23] Preservation of the cartilage has decreased the requirement for spreader grafts to reconstruct the midvault and internal valve.

Reconstructing the internal nasal valve is required in primary rhinoplasty when internal nasal valve dysfunction is present or if the internal nasal valve is not preserved during treatment of the dorsum. Secondary rhinoplasty more frequently requires reconstructing the internal nasal valve when the midvault was not preserved or reconstructed during the previous nasal surgery. These patients may have an inverted-V deformity, lateral wall weakness, and/or distortion of the dorsal aesthetic lines.

Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty.

Autospreader flaps also function to preserve or increase the internal nasal valve angle.[24-26] Although suture techniques have been described, spreader graft placement has proven the most reliable means and have been shown to improve nasal airflow substantially.[27] Grafts are placed between the dorsal septum and upper lateral cartilage. Proximally the grafts are placed underneath the bony dorsum. By increasing the angle between the upper lateral cartilage and dorsal septum, the internal valve is properly stented.[27-30] In addition to reconstructing the internal nasal valves, spreader grafts will help to restore the dorsal aesthetic lines.

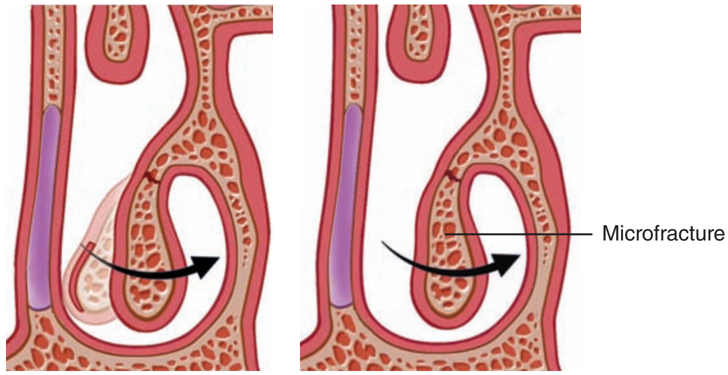


The dorsal spreader flap is particularly useful in secondary rhinoplasty where dorsal reduction is required in the patient with dorsal septal deviation and previous septal surgery. The cartilaginous dorsal reduction is planned and instead of excising the dorsal septum, the excess cartilage is turned over as a flap into the concave side of the septum. The flap is scored on the contralateral side to which it will be turned over. This technique makes use of intrinsic forces within the septal cartilage and oppose them.

Inferior Turbinates

Differentiating between mucosal disease and bony hypertrophy will allow for the appropriate treatment plan. Surgical maneuvers such as inferior turbinate outfracture, or submucous microfracture and/or resection will help to lateralize or decrease turbinate volume, respectively.[1,2,15,16] Mucosal hypertrophy secondary rhinitis may be better managed medically.

Septonasal deviations are a normal variant in human anatomy and are commonly associated with airway problems. This may lead to compensatory contralateral inferior turbinate hypertrophy. Even if airway obstruction is not present preoperatively, septal straightening may lead to narrowing of the anterior airway if inferior turbinate hypertrophy is present.



Mucosal hypertrophy

Bony hypertrophy

The hypertrophied inferior turbinates may subsequently interfere with septal repositioning and the postoperative airway. In most cases of mucosal hypertrophy, the inferior turbinate can be outfractured. In cases of bony hypertrophy, submucous microfracture and/or resection of the hypertrophied anterior inferior turbinate is performed to allow for an adequate postoperative airway.

Outfracture of the inferior turbinates is most often adequate to address inferior turbinate hypertrophy. Submucous microfracture and/or resection of the anterior inferior turbinate with resection of the hypertrophied bone may be necessary to maintain a straight septum and good nasal airway if inferior turbinate hypertrophy is present.

COMPLICATIONS

Persistent nasal airway obstruction is most commonly the result of misdiagnosis or inadequate treatment. Patients with medical diagnoses that are treated surgically will have refractory symptoms. If anatomic deformity is present it should be corrected. Lack of treatment or inadequate treatment of anatomic deformity will result in recalcitrant symptoms. However, patients should be educated on the limitations of operative treatment before their surgery.

Traditional approaches for septoplasty using cartilage scoring provide inconsistent results for correction of septal deviation. Excision of areas of septal deviation or spurs is more effective and predicable. When treating septal deviation, failures in improvement are commonly due to lack of adequate correction of the posterior septum. The closed approach provides limited visualization of the entire septum, especially the posterior septum. Additionally, the bony septum can be technically more challenging to remove than the cartilaginous septum. The open approach allows visualization of the entire septum and facilitates septal reconstruction under direct visualization. This is especially advantageous when addressing the bony septum.

Septal perforations can be avoided by ensuring elevation of the submucoperichondrial and submucoperiosteal flaps in the correct plane to prevent damage to the tissue. Small unilateral rents in the mucoperichondrium or mucoperiosteum do not need to be repaired. Larger lacerations should be sutured with chromic gut suture. If opposing bilateral lacerations occur, they should be repaired with chromic gut sutures, and interposition of cartilage or fascia grafts will help to stent the repairs and prevent mucosal growth across the contralateral side that can result in a perforation. Additionally, internal nasal splints can be placed, and the patient is instructed to gently sniff antistaphylococcal antibiotic ointment to keep the nasal cavity and splints moist to facilitate mucosal healing. The internal nasal splints will need to be kept in place for 1 to 3 weeks postoperatively, depending on the size of the mucosal lacerations.

Injured mucosal surfaces, when in opposition during nasal surgery, may form adhesions. Such adhesions or synechia are often clinically significant because they disrupt airflow and may lead to dysfunction of mucociliary clearance. To avoid this, care should be taken to avoid mucosal injury to opposing surfaces such as the lateral nasal wall and middle turbinate or nasal septum. If this does occur, internal nasal splints should be placed to separate the opposing surfaces.

Gustatory rhinorrhea, which is the profuse flow of thin clear nasal drainage on mastication, is very rare but may occur following septal surgery. The cause of gustatory rhinorrhea is postulated as inadvertent injury to the nasopalatine nerve within the septal layers after removal of the deviated portion of the vomer and the perpendicular plate of the ethmoid bone during septoplasty. Guyuron et al[31] posited that regenerating nerve sprouts are inappropriately directed toward nasal, rather than palatal, target receptors. Consequently, rhinorrhea results while eating. The pathophysiology of this problem is not dissimilar to gustatory sweating after parotidectomy. Although this complication is not life threatening, it is socially disturbing to patients. There is no effective treatment for gustatory rhinorrhea.

Inferior turbinate surgery has been associated with bleeding, mucosal crusting and desiccation, ciliary dysfunction, chronic infection, malodorous nasal drainage, and atrophic rhinitis.[1,2,15,16] In most cases, outfracture of the turbinates will be adequate to address mucosal hypertrophy and results in very little morbidity. However, in the case of bony hypertrophy, a submucous approach for microfracture and/or resection with preservation of the overlying mucosa will help to prevent these problems.

CONCLUSION

Comprehensive surgical management of the rhinoplasty patient should address both aesthetic and functional concerns. Nasal airway obstruction is common in patients presenting for rhinoplasty. The key structures causing nasal airway obstruction include the nasal septum, external nasal valve, internal nasal valve, and inferior turbinates. Both preoperative and intraoperative findings will guide treatment.

KEY POINTS

- Nasal airway obstruction is diagnosed from both history and physical examination and will guide surgical treatment planning.
- Anterior and inferior deformities tend to be poorly tolerated, because the cross-sectional area of the nasal airway is small compared with the posterior area in the nasal cavity.
- Airflow through the internal nasal valve may be limited when the angle formed by the junction of upper lateral cartilage and nasal septum is less than the typical 10 to 15 degrees.
- The inferior turbinate is commonly implicated in nasal airway obstruction because of its proximity to the internal nasal valve.

- Inferior turbinate hypertrophy may be mucosal only or may also involve the underlying bone.
- In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength.
- Microfracture should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. Septal cartilage or bone should be removed with ease, if there is any resistance, residual soft tissue attachments should be completely released.
- Preserving the structural integrity of the internal nasal valve is crucial when performing rhinoplasty.
- Outfracture of the inferior turbinates is most often adequate to address inferior turbinate hypertrophy. Submucous microfracture and/or resection of the anterior inferior turbinate with resection of the hypertrophied bone may be necessary to maintain a straight septum and good nasal airway if inferior turbinate hypertrophy is present.

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45

Classification of Septal Deviation and Reconstructive Technique

Bahman Guyuron

Nasal deviation can be a consequence of a deviated septum, deviated nasal bones, or often a combination of both.[1-10] The term *septal deviation* does not sufficiently define the pathology, and submucosal resection of the septum, a procedure often used for correction of every septal deformity, does not correct the nasal deviation. A clear understanding of the deformity and its precise correction can only be gained by careful analysis of the findings. This type of prudent assessment will lead to successful correction of an often challenging problem.

CLASSIFICATION

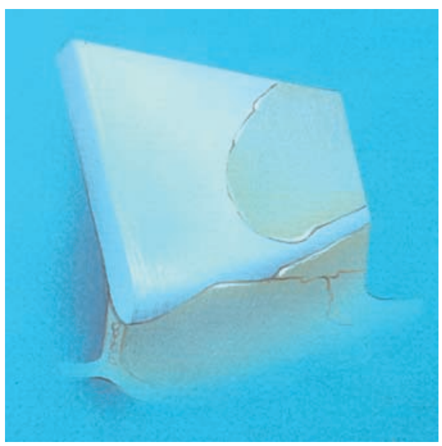
The septum and the nasal bones control the direction of the nose, and the deviated nasal bones can either be classified as a simple deviation on one side or a bilateral deviation. Often both nasal bones follow the deviated septum. Rarely, however, the nasal bones and the septum may shift independently.

There are six different categories of septal deviation, and each has a different pathology.

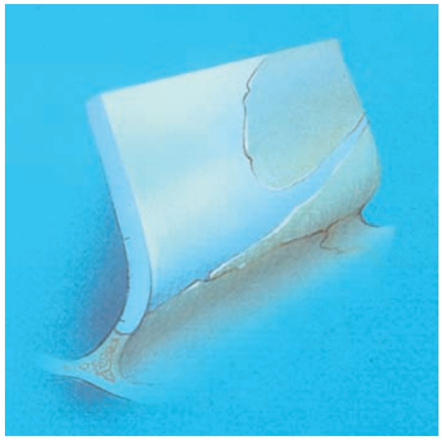
There are six classes of septal deviation, five of which may influence the external nose.[1] The final class, localized septal deviation or spur, will have no effect on the direction of the external nose.

Types of Septal Deformity, Incidence, and Treatment

	Septal Tilt (40%)	C-Shaped Antero-posterior (32%)	C-Shaped Cephalo-caudal (4%)	S-Shaped Antero-posterior (8%)	S-Shaped Cephalo-caudal (1%)	Localized Deviation or Spurs (15%)
Approach	Killian or transfixion	Anterior open	Anterior open	Anterior open	Anterior open	Killian
Scoring concave side		+ Horizontal unilateral	+ Vertical unilateral	+ Horizontal bilateral	+ Vertical bilateral	
Repositioning caudal septum on nasal spine	+	+	+	+	+	
Osteotomy of nasal spine		+	+	+	+	
Nasal osteotomy/ straighten septum	Doyle × 8 days	Simple stent × 3 weeks	Simple stent × 3 weeks	Simple stent × 3 weeks	Simple stent × 3 weeks	Overnight Doyle

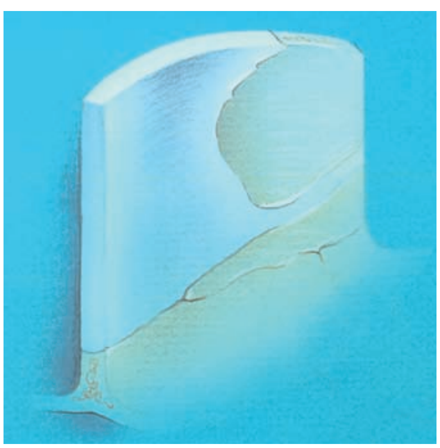


The most common type of septal deviation is a septal tilt. In this category the quadrangle cartilage and the perpendicular plate are, in general, free of any curvature. However, the cartilage is dislodged to one side of the maxillary crest internally and to the opposite side externally. An overwhelming majority of patients with nasal tilts are found to have internal deviation to the left and external deviation to the right. This pathology is often accompanied by an enlargement of the inferior turbinate ipsilateral to the external deviation.

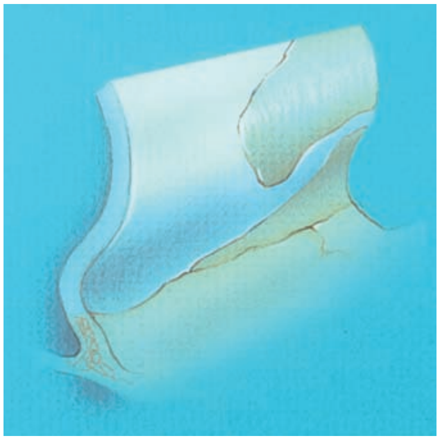
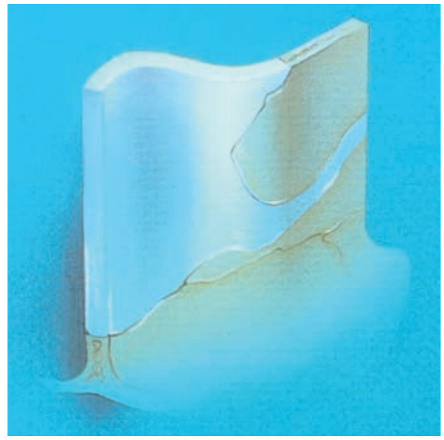


The second category of septal abnormalities is the C-shaped deviation. This deviation has two subcategories. In the first, the deviation is anteroposterior, which is the second most common type of septonasal deviation. This deformity includes a curve in the cartilage and is commonly associated with deviation of the vomer bone. This is in contrast to a nasal septal tilt in which the cartilage has no curves, yet is dislodged to one side, while the vomer bone is in a normal location with the cartilage often dislocated to one side of the maxillary crest. The external representation of the anteroposterior C deviation could be similar to the septal tilt.

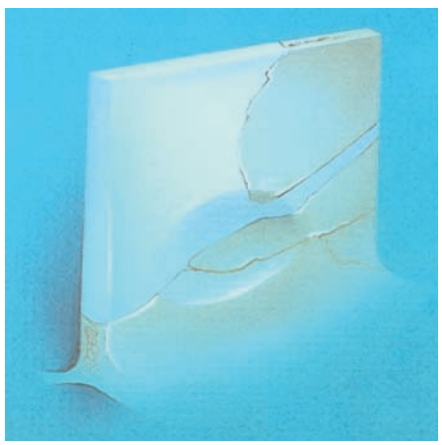
The different types of nasal septal deviation require different surgical management. A single conservative approach will fail to correct all the present deformities.



The C-shaped deviation can also be cephalocaudal, which externally will present as a C appearance in the direction of the nose. The cephalocaudal C deformity is less common. A variation of this deformity is deviation of the anterocaudal septum. This deformity only involves the caudal third of the anterior septum; the cephalic two thirds of the dorsum are straight.

The next type of septal deviation is an S-shaped septum, which can be anteroposterior or cephalocaudal. Both of these conditions are rare. The anteroposterior S shape will be reflected on the external nose as a shift to one side, whereas the S-shaped cephalocaudal deviation will result in an S-shaped deviation of the anterior nose as well.



The final category is the localized deviation. This is purely a functional problem and has no relevance to the shape of the nose externally.

All of the septal deviations described are often associated with enlargement of the middle or inferior turbinates, or a combination of both. The enlargement generally faces the concave side of the septum. The anteroposterior S- and C-shaped deviations most commonly result in enlargement of the middle turbinates as well as the inferior turbinates.

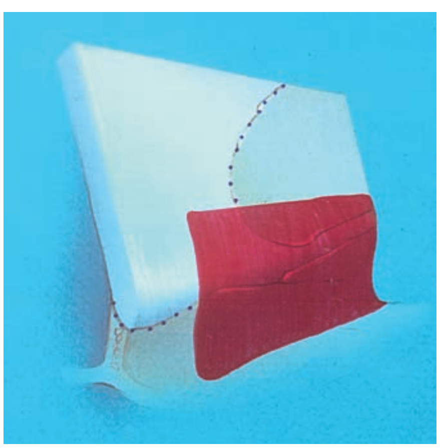
PREOPERATIVE CONSIDERATIONS

The management of nasal bone deviation depends on the degree of deviation and the type of deformity. If only one nasal bone has been affected and the rest of the nose is in a proper position, the surgeon may choose to camouflage this deviation with the addition of a cartilage graft, as long as there are no functional consequences. Outfracture of the nasal bone, although a possibility, is not always predictable. If the nasal bone on one side is shifted medially and the opposite side is shifted laterally, the surgical technique will include bilateral osteotomy and repositioning of the nasal bones. One may infracture the laterally shifted nasal bone and outfracture the medially shifted nasal bone. If the nasal bones are parallel and both are deviated to one side, then bilateral, cephalic, and lateral osteotomies and repositioning of the nasal bones while maintaining the relationship of the bones to each other will yield the best outcome. However, this maneuver is difficult and rarely necessary.

Outfracture of the nasal bone, although a possibility, is not always predictable.

Depending on the type of deformity, the surgical approach and the exposure will be different. When a deviation involves the anterior septum, an open technique is preferred. The posterior or localized deviation can be approached either through a Killian incision or a hemitransfixion incision. However, these are rare deformities. For that reason, the majority of the deviations require an anterior open technique.

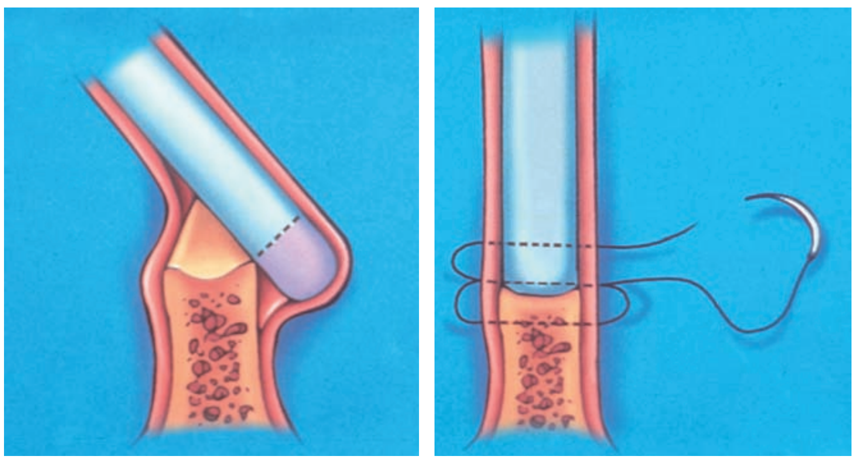
OPERATIVE TECHNIQUE



The optimal choice for correction of a nasal tilt is removal of the posterior portion of the septum, leaving an L-shaped septum anteriorly and caudally, ensuring that at least 15 mm of the anterior portion of the L-strut is maintained.

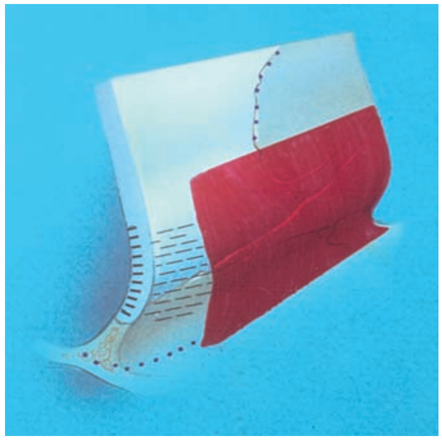
Nasal tilts are corrected by first removing the posterior portion of the septum, leaving at least 15 mm of the anterior portion of the L-strut. The overlapping portion of the caudal septum is removed and the cartilage is repositioned and fixed to the anterior nasal spine.

This maneuver in itself will not result in repositioning of the anterior septum in the majority of cases, although on rare occasions the septum may subsequently become straight. Commonly, the residual portion of the posterocaudal portion of the L-shaped septum is dislodged to one side of the vomer bone and the nasal spine. This may require repositioning after removal of a small segment of overlapping cartilage and fixation in a new position.

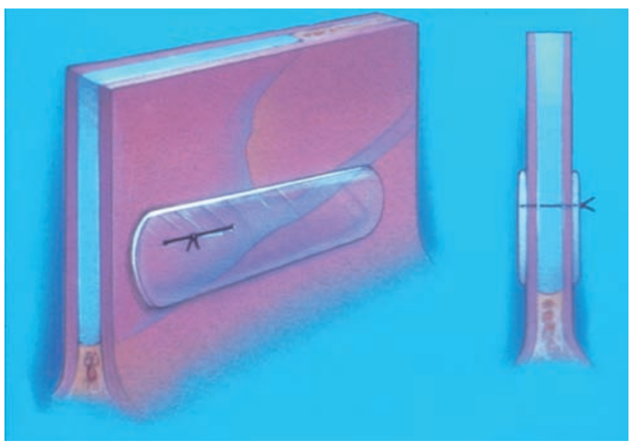


A figure-of-eight suture is used for this maneuver. Before this repositioning and fixation, it is crucial to ensure that the anterior nasal spine is located in the midline. Otherwise, the caudal posterior septum will be fixed to an abnormally positioned structure. If the anterior nasal spine is malpositioned, it can be repositioned with an osteotomy. It is sometimes necessary to mobilize the junction of the quadrangle septal cartilage and the perpendicular plate to reposition the anterocephalic portion of the septum.

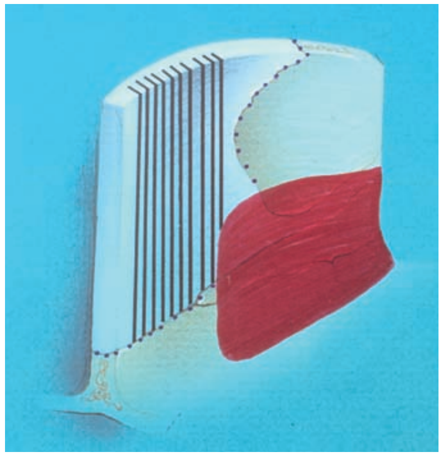
Before repositioning and fixation of the anterior septum, it is crucial to ensure that the anterior nasal spine is located in the midline.



Correction of the cephalocaudal deviation is different from that for the C anteroposterior deviation and nasal tilt. Correction of the class II C-shaped anteroposterior deformity requires resection of the posterocaudal septum leaving an L-strut, osteotomy of the nasal spine and residual vomer plate, partial disjunction in the quadrangle cartilage and perpendicular plate only if absolutely necessary, and cephalocaudal scoring of the cartilage if the cartilage does not correct the curvature itself, which it often does.



The cartilage memory will then be guided with bilateral extramucosal stents (Simple Splints), fixed in position with a through-and-through suture. The stents are kept in place for 3 weeks and the patient is maintained on oral antibiotic agents during the treatment course.



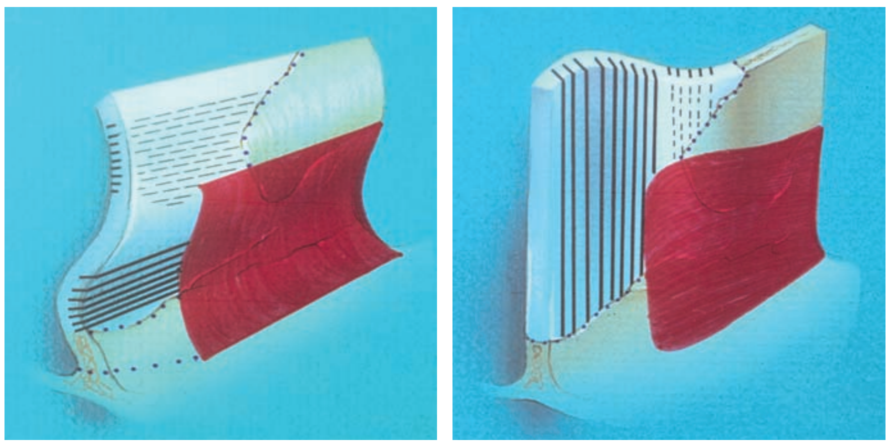
The class III septal deviation, C-shaped cephalocaudal deformity, is corrected by resection of the posterior septum, anteroposterior scoring of the concave side, only if necessary, complete freeing of the junction of the cartilaginous septum and maxillary crest, as well as partial release of the cephalic portion of the quadrangle cartilage from the perpendicular cartilage and nasal spine osteotomy, if there is an angulation. The cartilage memory will then be guided with extramucosal stents posteriorly and a pair of spreader grafts anteriorly. Should the deviation only involve the caudal septum, a septal rotation suture will be used along with bilateral spreader grafts.[2]

The residual anterior deviation of the septum should be corrected using a septal rotation suture.

Any time there is a curvature in the septum, scoring on the concave side and placement of either spreader grafts or internal extramucosal nasal stents is done, only if necessary.

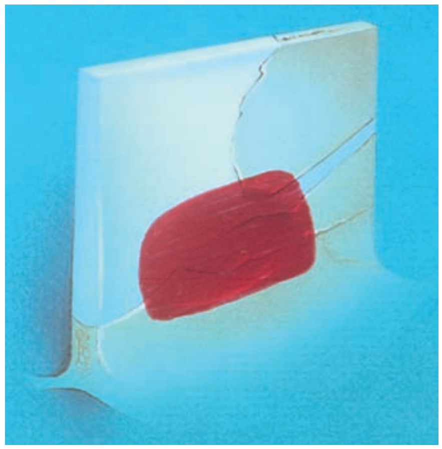
Residual curvatures of the septum may require scoring on the concave side and spreader grafts or internal extramucosal nasal stents to control the cartilage response.

Using a combination of both is often essential to guide the scored cartilage memory to ensure straightening of the cartilage. Here again, the surgeon must often remove the posterior portion of the septum, vomer plate, and perpendicular plates. An osteotomy of the nasal spine and residual portion of the vomer plate will also be performed. The curved portion of the cartilage will then be scored. If the curve is anteroposterior, the scoring will be done on the concave side cephalocaudally. If the curve is cephalocaudal, the concave side will be scored anteroposteriorly. The importance of the spreader graft and extramucosal stents cannot be overstressed. It is rarely necessary to partially mobilize the junction of the quadrangle cartilage and the perpendicular plate if there is an angulation at this junction.



The S-shaped deviation will be corrected using the same principles. The posterior portion of the cartilage is resected. This time the scoring will be done bilaterally on the concave portion. If the deviation is cephalocaudal, the scoring will be anteroposterior, and if the deviation is anteroposterior, the scoring will be cephalocaudal. The nasal spine and vomer bone will be repositioned with an osteotomy along with partial mobilization of the perpendicular plate and quadrangle junction if there is an angulation at this junction. The anterior portion of the septum is then supported with bilateral spreader grafts, and the cartilage memory is guided using bilateral extramucosal stents posteriorly.

S-shaped deviations may rarely require scoring, osteotomy, and partial mobilization of the perpendicular plate and quadrangle cartilage junction, should there be an angulation at this junction.

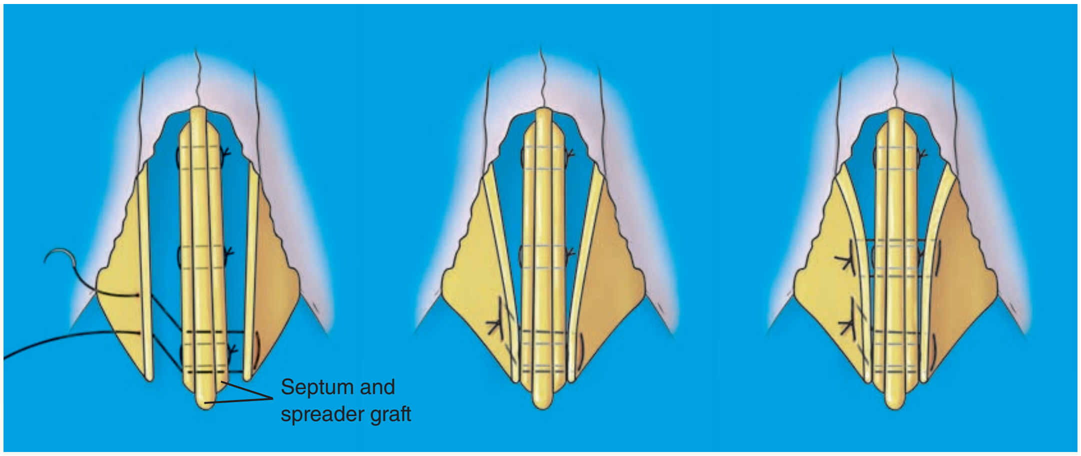


The localized deviation can be corrected simply by removal of the deviated portion of the cartilage, which may involve the septal cartilage, the vomer plate, the perpendicular plates, and application of Doyle or simple stents.

If the deviation involves the anterior septum, an open technique is preferred.

The dorsum is skeletonized and the upper lateral cartilages are separated. A mucoperichondrial flap is elevated on one side, and the septal deviation is corrected depending on the problem. Spreader grafts are then applied and the upper lateral cartilages approximated. If the deviation is posterior or localized only, either a Killian-type incision or a transfixion incision may be used. Even a hemitransfixion incision can be used for this part of the correction.

If the septum still appears deviated to one side caudally after placement of the spreader graft, it can be repositioned using the upper lateral cartilage as an anchor using the septal rotation suture.



To place a septal rotation suture in an attempt to correct a caudal third anterior septal deviation, a 5-0 PDS suture is passed slightly cephalically through the upper lateral cartilage contralateral to the deviation, then passed through the septum–spreader graft and the ipsilateral upper lateral cartilage composite slightly caudally and tied to pull the septum to the midline.[2] The posterior portion of the septum is then supported with an extramucosal stent for 3 weeks to guide the cartilage memory and avoid dead space if the cartilage has been scored. Otherwise, the Doyle stents are kept in place for 4 to 8 days.

KEY POINTS

- There are six different categories of septal deviation, and each has a different pathology.
- The different types of nasal septal deviation require different surgical management. A single conservative approach will fail to correct all the present deformities.
- Outfracture of the nasal bone, although a possibility is not always predictable.
- Nasal tilts are corrected by first removing the posterior portion of the septum, leaving at least 15 mm of the anterior portion of the L-strut. The overlapping portion of the caudal septum is removed and the cartilage is repositioned and fixed to the anterior nasal spine.
- Before repositioning and fixation of the anterior septum, it is crucial to ensure that the anterior nasal spine is located in the midline.
- The residual anterior deviation of the septum should be corrected using a septal rotation suture.
- Residual curvatures of the septum may require scoring on the concave side and spreader grafts or internal extramucosal nasal stents to control the cartilage response.

- S-shaped deviations may rarely require scoring, osteotomy, and partial mobilization of the perpendicular plate and quadrangle cartilage junction, should there be an angulation at this junction.
- If the deviation involves the anterior septum, an open technique is preferred.
- If the septum still appears deviated to one side caudally after placement of the spreader graft, it can be repositioned using the upper lateral cartilage as an anchor using the septal rotation suture.

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Acute Nasal Fracture Management: Minimizing Secondary Nasal Deformities

Rod J. Rohrich ▪ William P. Adams Jr. ▪ Jamil Ahmad

Less force is required to cause nasal pyramid fractures than any other facial bone fractures. For this reason and because of the prominence of the nose, nasal fractures are the most commonly seen facial fractures.[1-6] The prevalence of this injury is increasing, and treatments are challenging. Nasal fractures are often discussed as minor injuries[7]; however, the incidence of posttraumatic nasal deformity is alarmingly high (14% to 50%). Because revision rhinoplasty for traumatic nasal deformity can be difficult, guidelines are needed to optimize management of acute nasal fractures.

Nasal fractures are the most common facial fracture.

Current management approaches to acute nasal fractures result in a high incidence of posttraumatic nasal deformity (14% to 50%).

Numerous factors contribute to suboptimal functional and aesthetic results, including timing, edema, undetected preexisting nasal deformity, and occult septal injury and deviation. Therefore we have devised a clinical algorithm for acute nasal fracture management that includes a complete evaluation of the nasal deformity (external and internal) and precise anatomic reduction under controlled

Chapter excerpted from Rohrich RJ, Adams WP Jr. Nasal fracture management: minimizing secondary nasal deformities. Plast Reconstr Surg 106:266-273, 2000.

conditions to improve long-term results and reduce posttraumatic nasal deformities (see p. 1024).[1]

Associated traumatic edema, preexisting nasal deformity, and occult septal injury account for most acute reduction failures.

We have formulated a clinical algorithm for acute nasal fracture management that is based on a patient's detailed history and physical examination.

Since Maliniac[8] published his classic book on management of acute nasal injuries in 1947, considerable debate has persisted regarding optimal care of acute nasal fractures. Discrepancies in timing, method, and postoperative management are common in the literature. Many approaches to the management of acute nasal fractures have been described.[1-4,9-19]

INCIDENCE OF POSTTRAUMATIC NASAL DEFORMITY

The incidence of postreduction nasal deformities (excluding this study) that require subsequent rhinoplasty or septorhinoplasty ranges from 14% to 50%.[9,20,21] Several authors report poor results with simple closed manipulation for acute nasal fractures.[1,9,21-25]

Incidence of Secondary Nasal Deformity After Acute Closed Nasal Fracture Reduction

Author	Percentage of Patients With Secondary Nasal Deformity (No. of Cases)
Watson et al[21]	29-50 (29)
Cook et al[22,23]	14-17 (45)
Murray et al[24]	41 (756)
Waldron et al[25]	14-15 (100)
Rohrich and Adams[1]	9 (110)

Fry[26,27] and Mayell[28] described unfavorable structural and aesthetic outcomes after nasal fractures. Waldron et al[25] conducted a prospective study that compared local versus general anesthesia for closed reduction. They reported a 14% to 16% incidence of postreduction deformity (in both groups) at 3 months, requiring further surgery. Of patients with initially identified traumatic septal deviation,

40% to 42% had significant septal deformity at 3 months and required septorhinoplasty. Cook et al[22] published a randomized prospective series of 50 patients in which they compared anesthesia for simple reduction of nasal fractures. They found a 14% to 17% incidence of postreduction deformity requiring further surgery. In their prospective series of 756 patients treated with simple reduction, Murray and Maran[10] reported a 41% incidence of postreduction deformity. They stated quite appropriately, "When outcome of simple manipulation is assessed objectively, the technique has a poor success rate; only a proportion of noses are made straight and quite a number left unaltered." In our analysis of 110 rhinoplasty patients treated over the past 11 years by the senior author (R.J.R.), the revision rate was 9% (10/110).[1]

The incidence of posttraumatic nasal deformity after simple closed reduction in the emergency room ranges from 15% to 42%.

We have had a 9% nasal revision rate in 110 patients treated over an 11-year period.

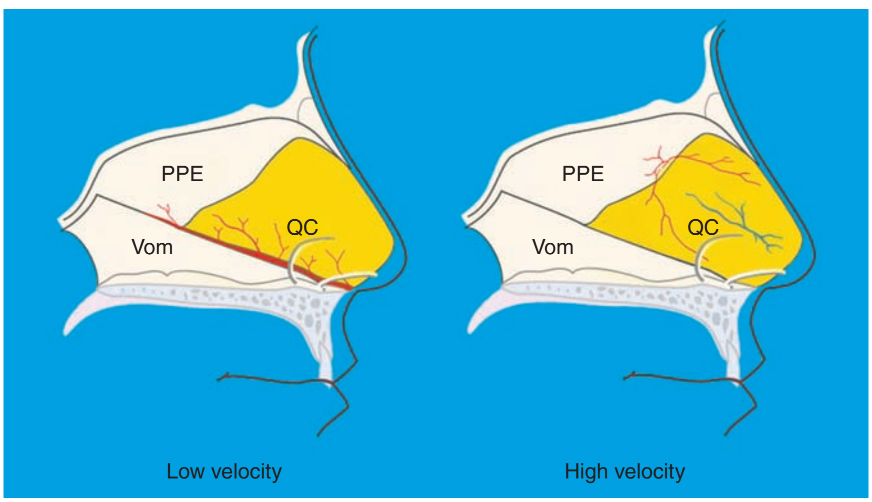
UNRECOGNIZED SEPTAL DEFORMITY

The nasal septum, the single most important structure in determining aesthetic and functional outcome in nasal fractures, must be completely assessed.[5-7] Verwoerd[7] described the pathogenesis of septal fractures, including three septal zones with thicker cartilage (dorsoposteriorly, basally, and caudally). Conversely, the central caudal portion of the septum is thin. The thicker, posterior septal cartilage provides the primary support to the nasal dorsum. Trauma to the nasal dorsum leads to lesions in the caudobasal to cephalodorsal supporting cartilage and horizontal fractures of the thinner central region.[7]

Fry[26,27] demonstrated progressive distortion of fractured septal cartilage caused by the releases of locked internal stresses. Verwoerd[7] and Wexler[29] demonstrated that the septum does not remain straight after manipulation, and the nasal bones tend to unite in the direction of the deviated septum. In our experience the septum is the key structure to align/correct and optimize nasal fracture management and minimize secondary deformity.[30]

Assessment of the extent of septal injury is important to the selection of the proper technique for septal correction. Renner[3] reported that closed reduction with intranasal splints/packs yielded satisfactory results in most simple septal injuries involving the distal portion of the quadrangular cartilage. Pollock[11] ad-

vocated a low threshold for open reduction with precise septal correction for moderate to severe septal injuries with complex fracture patterns or involvement of the perpendicular plate of the ethmoid or vomerine groove. In the absence of complete evaluation of the entire septum, the mobile anterior portion is reduced and the rigid posterior septum remains dislocated, resulting in late functional deformity after closed reduction. In 1968 Adamson et al[31] advocated acute submucous resection for severely fractured septa. Harrison[32] recognized that low horizontal submucous septal resection that removes only the quadrangular cartilage–vomerine groove interface was often not adequate because of the overlapping fractured segment in the perpendicular plate of the ethmoid; he recommended an extended, low horizontal and posterior vertical submucous resection to fully address septal pathology. Murray et al[24] also attributed the high rate of postreduction nasal deformity requiring salvage septorhinoplasty to an unrecognized septal injury. They found that patients whose nasal bones were deviated by more than half the nasal bridge width had a concomitant C-shaped fracture of the bony and cartilaginous septum. They also concluded that acute open reduction with submucous septal resection resulted in an improved long-term cosmetic and functional outcome, because it alleviated overlapped, interlocking fragments of the septum that usually resulted in secondary nasal bone deformity.



In our experience the most common septal fractures in low-velocity injuries occur inferiorly along the vomerine groove *(Vom)* either as fractures or fracture-dislocations.[1] High-velocity injuries or frontal impact result in more extensive septal fractures through the thin central region of the quadrangular cartilage *(QC),* extending posteriorly across the interface with the perpendicular plate of the ethmoid *(PPE)* and inferiorly to the vomer. Aggressive management of these septal injuries is the key component in the prevention of functional nasal airway problems and essential for successful management of the nasal fracture.

Identification and management of septal fractures are key elements to prevent functional nasal airway problems and successfully manage nasal fractures.

PREOPERATIVE ASSESSMENT

A detailed nasal history and physical examination are essential (see p. 1016). A precise account of the mechanism, including injuring agent, direction of blow, and timing of nasal injury, is recorded. A history of epistaxis, sine qua non for a nasal fracture, indicates a laceration of the involved nasal mucosa.[5]

The findings are recorded on the nasal fracture data sheet.[1] Patients vary in preinjury nasal shape. It is sometimes difficult to differentiate between new and old nasal deformity; a correlation of the history and physical findings is required. Reviewing old photographs or a driver's license photograph is helpful. The standard seven-view nasal photographs are taken (AP, right and left lateral, right and left oblique, and low and high basal).

The physical examination consists of an integrated systematic approach. The external examination includes inspection for lacerations, wounds, swelling, and deviation, and palpation of the proximal nasal skeleton to identify tenderness, crepitus, depression and/or nasal shortening, and widening of the nasal base. Accurate intercanthal distance is measured to rule out a nasoorbital ethmoid fracture, commonly noted with severe high-velocity frontal or inferior injuries. The type of fracture is defined. In some cases, the fracture pattern is different on right and left sides of the facial skeleton. Various nasal fracture classifications have been reported.[11,12,15,18,33] We have adopted a practical, clinically applicable nasal fracture classification based on the physical examination (see p. 1016). The results of the physical examination are recorded on the nasal fracture data sheet. Edema is graded by the degree of periorbital edema present (1 = Minimal/no periorbital edema; 2 = Moderate periorbital edema; 3 = Severe periorbital edema).

The internal examination requires at a minimum halogen lighting, good suction, a nasal speculum, vasoconstrictive anesthesia, and a 30-degree 3 mm rigid nasal endoscope if the fracture is type III or greater. A complete evaluation of the internal structures, especially the posterior septum, is performed. The deformity and evidence of obstruction are recorded on the data sheet. A rigid nasal endoscope may be used to fully evaluate the entire septum, especially the posterior bony septum and vomerine regions in types III, IV, and V nasal fractures. A topical anesthetic consisting of 4% lidocaine and oxymetazoline (Afrin) or phenylephrine hydrochloride (Neo-Synephrine) will suffice for a complete examination of an awake patient. A complete septal evaluation is central to evaluating nasal

NASAL FRACTURE DATA SHEET

Name: ______________________________
Date: ______________________________
Age: ______________________________

Mode of injury: ☐ Low energy ☐ High energy

Direction: ____________________ Appearance: ____________________

Time since injury: ______________________________

Associated injury: ☐ Soft tissue ☐ Facial fracture

HISTORY

Allergies: ______________________________

Previous nasal trauma: ______________________________

Previous nasal surgery: ______________________________

Airway obstruction: ______________________________

Medications: ______________________________

Pretraumatic photos: ☐ Yes ☐ No

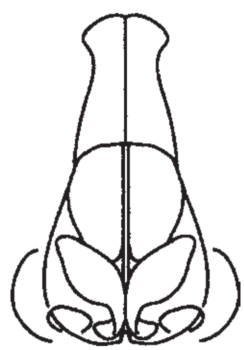
PHYSICAL EXAMINATION

1. ☐ Unilateral ☐ Bilateral (width of nasal base)
2. Edema: 1+ 2+ 3+
3. Intercanthal distance: ____________________
4. Ecchymosis: 1+ 2+ 3+
5. Nasal bleeding: ☐ R ☐ L ☐ Bilateral ☐ None
6. Internal nasal examination

   Septal deviation/dislocation/fracture: ______________________________

   Mucosal status: ______________________________

   Septal hematoma: ☐ Yes ☐ No



NASAL FRACTURE CLASSIFICATION

I. Simple (unilateral)
II. Simple (bilateral)
III. Comminuted unilateral
IIIA. Comminuted bilateral
IIIB. Comminuted frontal
IV. Complex (nasal bone and septal disruption)
V. Associated naso-orbital ethmoid fracture/midface fracture

fractures and optimizing results; therefore adequate anesthesia is essential for a complete systematic evaluation.

After adequate vasoconstriction and topical anesthesia of the nasal mucosa, the diagnostic endonasal examination can proceed, if desired. The patient is seated in an examining chair with the examiner usually sitting or standing to the right side of the patient. The endoscope is placed in the nasal vestibule and under direct vision is advanced posteriorly along the floor of the nose and beneath the inferior turbinate. Areas examined include the inferior meatus, turbinates, septum, and posteroinferior septal junction with the perpendicular plate of the ethmoid. Withdrawal of the scope allows confirmation of fractures and septal disruption. Although the endoscope offers excellent visualization, we usually rely on thorough inspection and examination with a headlight and speculum.

The septal mucosa is inspected for tears and evidence of septal fractures. Prompt diagnosis and treatment of septal hematoma are essential to reduce fibrosis and subsequent septal distortion, abscess, and complete necrosis with resulting saddle-nose deformity. Wide, dependent drainage followed by careful packing with antibiotic gauze is recommended.[9] Small hematomas can be aspirated with close patient follow-up to determine whether reaspiration or drainage is necessary.[3] We prefer incisional drainage over aspiration.

Prompt diagnosis and treatment of septal hematoma are essential to reduce fibrosis and subsequent septal distortion, abscess, and complete necrosis with resulting saddle-nose deformity.

Plain film radiographs are not necessary in the clinical diagnosis of isolated nasal fractures.[3,34] Logan et al[35] reported a prospective series in which routine radiographs were evaluated to diagnose nasal fractures. They concluded that plain films were not cost effective; however, patients who had displaced nasal fractures on radiographs were at higher risk for long-term nasal deformity, and anatomic reduction was highly recommended.

Plain film radiographs are not necessary in the clinical diagnosis of isolated nasal fracture and are not cost effective.

Type IV nasal fracture complex (nasal bone and septal disruption)

After a high-energy mechanism of injury, significant facial swelling prevents appropriate physical examination, and associated injuries of the craniofacial skeleton may be. These cases require a CT scan of the facial skeleton to provide detailed information on suspected the pattern of nasal and septal fracture and the extent of facial structures involved.

In some cases, CT of the face should be obtained to provide beneficial detailed information on the pattern of nasal and septal fractures and the extent of facial structures involved.

MANAGEMENT AND OPERATIVE TECHNIQUE

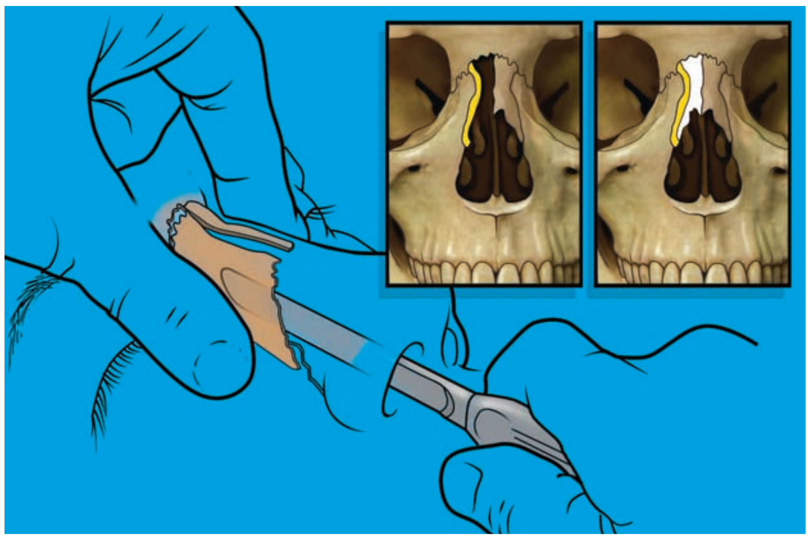
Numerous prospective series have been published comparing local versus general anesthesia for manipulation of nasal fractures.[21,22,25] In most cases, these studies prove local anesthesia to be as effective clinically and less expensive than general anesthesia for closed reduction. Wang et al[5] stated that most adults with uncomplicated fractures can be treated using closed or open techniques with topical/local anesthetics and intravenous sedation. Cook et al[23] found externally infiltrative field anesthesia to the nasal dorsum to be as effective and better tolerated than bilateral specific internal blocks of the infraorbital, infratrochlear, and external nasal nerves. With the external technique, the needle is introduced bilaterally at the caudal edge of the nasal bone, midway between the nasal bridge and maxilla.

We recommend a brief-acting general anesthetic for complete nasal fracture reduction and find that this approach is safe, controls the airway, and allows uncompromised nasal examination, reduction, and manipulation.[1] We reserve local anesthesia with intravenous sedation for treatment of simple type I and II fractures or for patients who request it. We perform nasal reductions in our day-surgery center regardless of the type of anesthesia to maximize the use of superior lighting, nasal fracture/rhinoplasty instruments, and enhanced technical assistance available in this setting.

This approach yields more consistent and controlled outcomes with less patient discomfort. Children, however, routinely undergo nasal manipulation under general anesthesia. Similarly, adults with polytrauma require repair of multiple injuries under a general anesthetic. A topical vasoconstrictive agent (Afrin) and 8 to 10 ml of 1% lidocaine with 1:100,000 epinephrine is always used for nasal hemostasis.

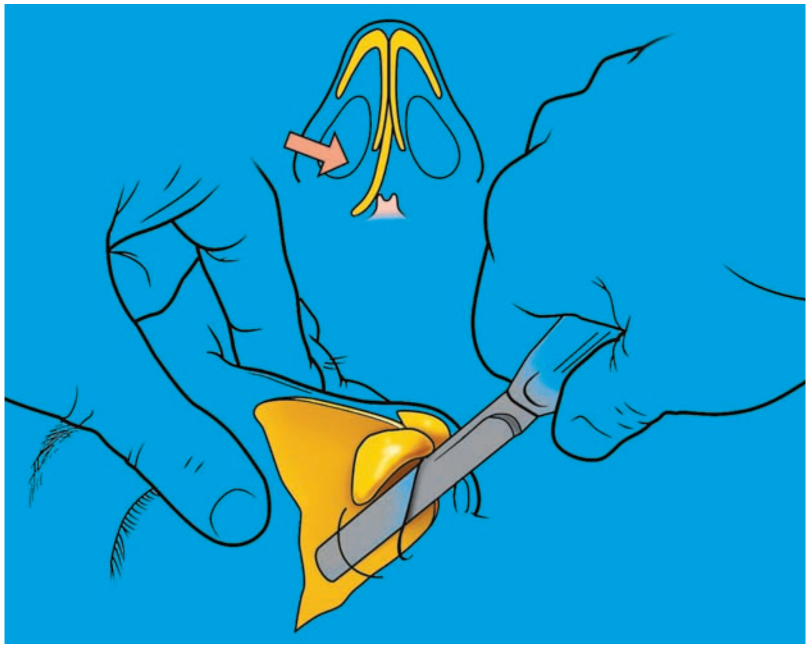
Nasal fracture reductions should be performed in the controlled setting of an outpatient surgery center with IV sedation or a brief-acting general anesthetic to optimize results.

Initially external nasal bones are reduced to an anatomic position by re-creation of the fracture. Molding the nasal bones using fingers is the simplest approach.[11,33,36] Impacted nasal bones require instrumentation for reduction and restoration of nasal length (the most critical dimension to restore). Walsham forceps are designed to reduce impacted nasal bones.[3,33] Asch forceps are designed to reduce the nasal septum but can be successfully used to restore alignment of impacted nasal bones. Both of these instruments will cause damage to the nasal mucosa.



We prefer to use the less traumatic Boise elevator. The elevator is placed intranasally and the surgeon's thumb externally over the nasal bones to detect subtle osseous movements.[1,3]

To minimize nasal mucosal trauma, a Boise elevator should be used to reduce nasal bone fractures.

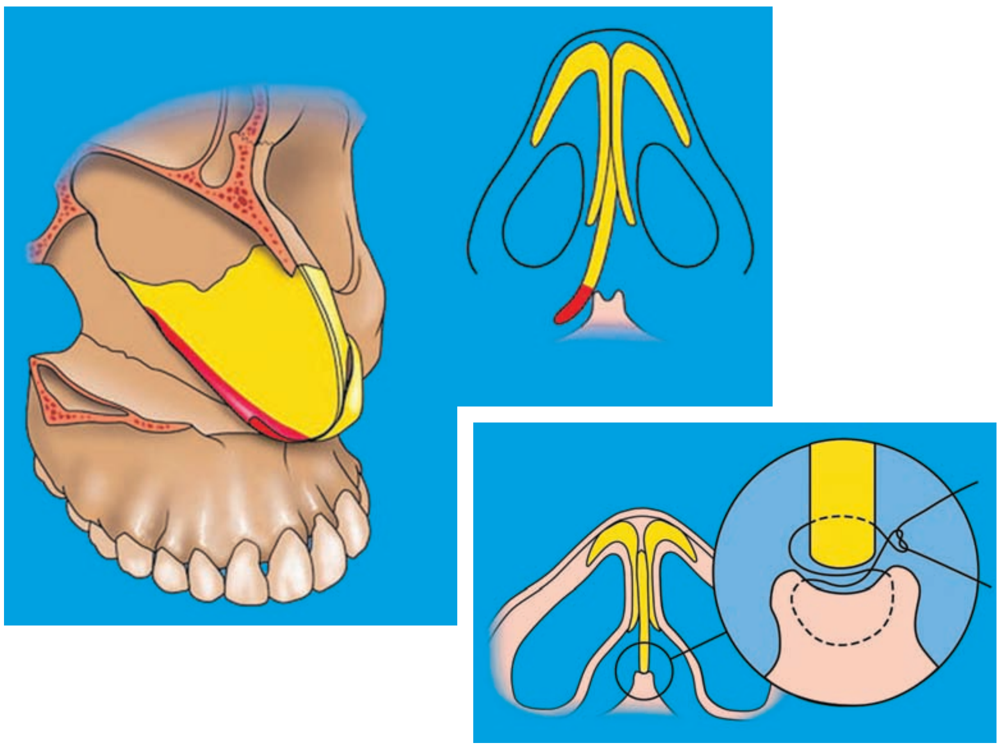


Reduction of the fractured nasal septum begins with relocation of the displaced base into the vomerine groove.[1] This is accomplished with either an Asch forceps or a blunt Boise elevator. If the septum is reduced with a simple technique, it should be reexamined endoscopically or with a nasal speculum and headlight to ensure alignment of posterior elements. Nasal bone reduction should be reassessed, because shifting can occur during septal manipulation.[11] After comminuted nasal bones are reduced, dorsoposterior intranasal packing with Oxycel helps to prevent collapse.

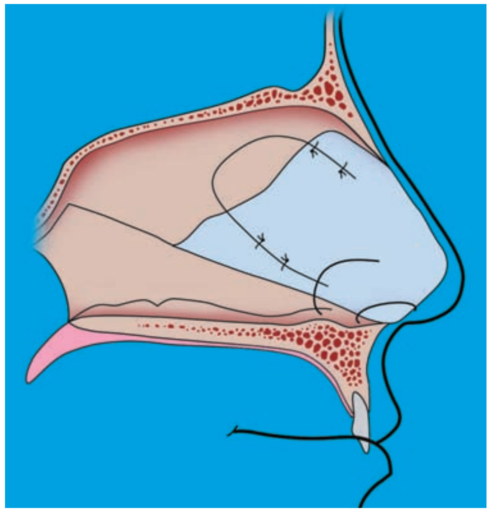
Acute septal reconstruction is considered for patients with a nonreducible anterior or posteroinferior septum, especially those with type IV fractures. This may be associated with a slightly increased risk of loss of traumatized nasal mucosa during undermining with subsequent septal perforation. Nevertheless, given the extremely high rate of posttraumatic nasal deformity secondary to malaligned or occult septal injury, surgeons should perform a total anatomic septal reduction and/or reconstruction if the injury is acute and the septum is irreducible and posteriorly displaced.

Septal fractures need to be anatomically reduced to prevent long-term nasal deviations. Those that cannot be reduced adequately require submucous resection.

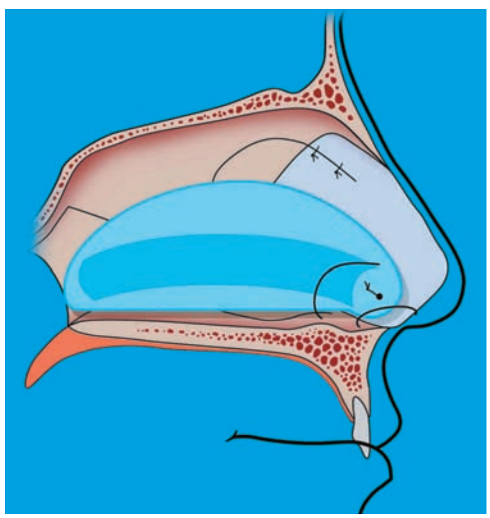
A hemitransfixion or Killian incision is made, and bilateral inferior mucoperichondrial flaps are developed. Complete visualization of the septum is required to define the extent of injury.



An inferior and posterior septal reconstruction to dislodge and align the septum and/or reposition the septum may be performed with anterior septal spine figure-of-eight sutures with a 5-0 PDS suture to keep the septum aligned and straight.[1]

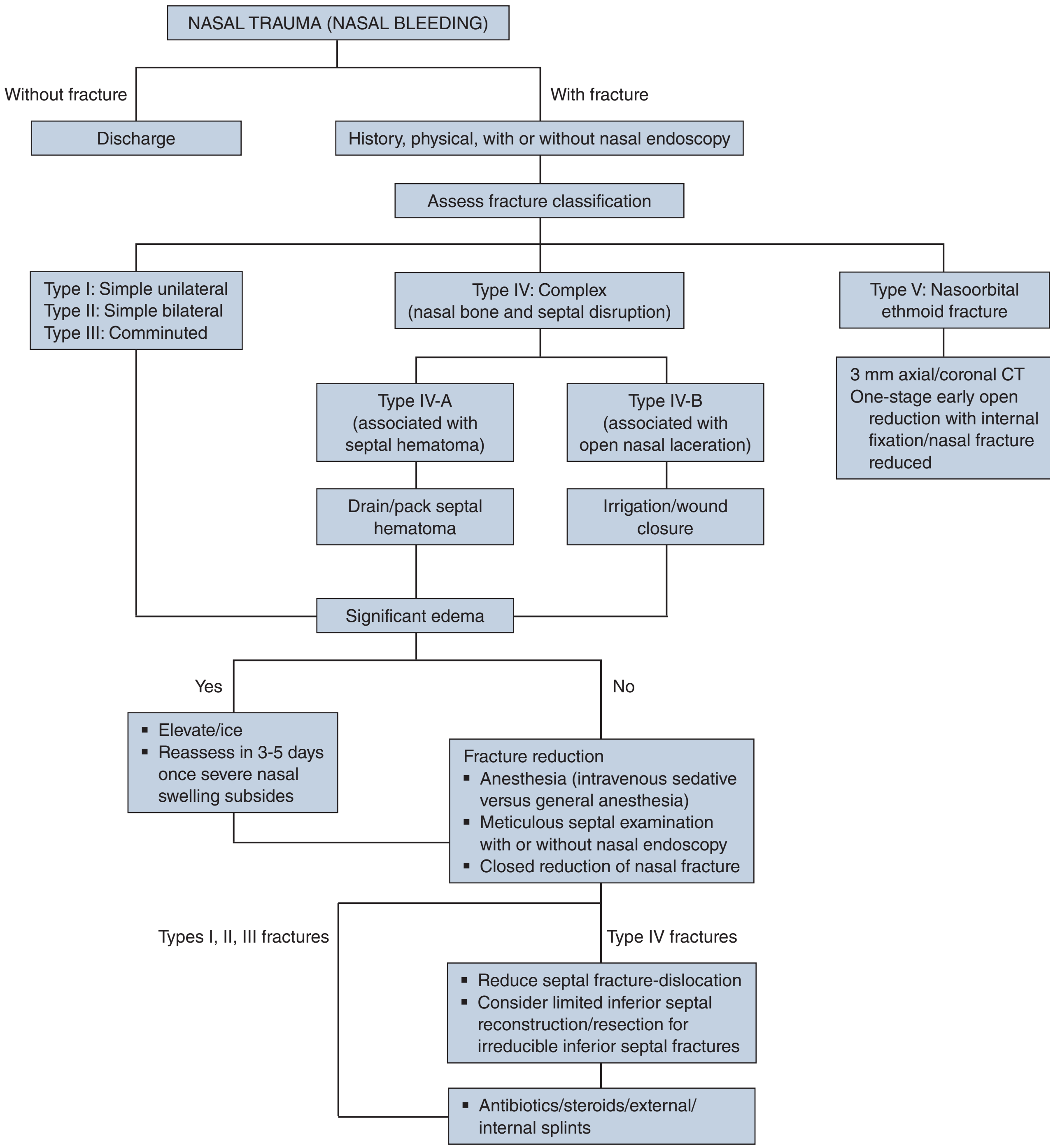


Reduced fractures of the septum are precisely reapproximated with through-and-through mucosal-septum-mucosal 4-0 chromic mattress sutures.[1]



Doyle splints are recommended to further stabilize the caudal septum.[1] Intranasal and external splints are used for 5 to 7 days to maintain and protect reduced fractures.

Clinical Algorithm



We have formulated a clinical algorithm for acute nasal fracture management to minimize the incidence of posttraumatic deformity requiring revision septorhinoplasty.[1] We caution, however, that an algorithm is merely a framework on which to base clinical decisions and does not supplant sound clinical judgment.

The following points are emphasized:

- The diagnosis of acute nasal fractures is based on a complete history and physical examination, including an intranasal examination, and not on radiographic studies.
- In patients with significant posttraumatic swelling that precludes immediate precise reduction, a clinical examination is performed and local measures prescribed (ice, elevation), with follow-up in 3 to 5 days. Definitive treatment is instituted 5 to 7 days after injury, depending on the edema of the nose. In isolated cases, treatment can be delayed 10 to 12 days without significant problems with bone mobilization.
- The septum is the key structure in nasal fracture management. All septal pathology, especially posteriorly, must be identified via the clinical examination and rigid nasal endoscopy. Significant septal fractures are directly visualized, and limited septal resection, reconstruction, and repositioning are considered.
- This algorithm will yield improved long-term functional and aesthetic results; however, all patients should be initially counseled regarding the the possible need for additional nasal procedures.

The low incidence of revision is attributed to complete nasal assessment (bony and septal), fracture reduction using general anesthesia, and primary septal reconstruction in patients with severe septal fracture dislocations.

CONCLUSION

Acute nasal fracture management has often been inadequate and associated with a high incidence of long-term nasal deformity. Primary factors that contribute to poor long-term results include acute traumatic edema, unrecognized preexisting nasal deformity, and undetected posterior and inferiorly displaced septal fractures. Given these variables, we have devised a practice algorithm for acute nasal fracture management. This algorithm was developed and refined during an 11-year series of 110 patients. However, we were not able to stratify these patients with regard to fracture type. Treatment failures generally occurred in patients with severe, difficult-to-reduce septal injuries; this emphasizes the importance of the septum and the restoration of a functional nasal airway.

Most reductions are performed in the operating room with appropriate anesthesia 3 to 7 days after injury. Irreducible septal injuries should be treated with limited inferior septal reconstruction in the acute phase to diminish secondary nasal deformity. With this algorithm, the need for extensive and difficult posttraumatic revision rhinoplasty should be significantly reduced.

KEY POINTS

- Nasal fractures are the most common facial fracture.
- Current management approaches to acute nasal fractures result in a high incidence of posttraumatic nasal deformity (14% to 50%).
- Associated traumatic edema, preexisting nasal deformity, and occult septal injury account for most acute reduction failures.
- We have formulated a clinical algorithm for acute nasal fracture management that is based on a patient's detailed history and physical examination.
- The incidence of posttraumatic nasal deformity after simple closed reduction in the emergency room ranges from 15% to 42%.
- We have had a 9% nasal revision rate in 110 patients treated over an 11-year period.
- Identification and management of septal fractures are key elements to prevent functional nasal airway problems and successfully manage nasal fractures.
- Prompt diagnosis and treatment of septal hematoma are essential to reduce fibrosis and subsequent septal distortion, abscess, and complete necrosis with resulting saddle-nose deformity.
- Plain film radiographs are not necessary in the clinical diagnosis of isolated nasal fracture and are not cost effective.
- In some cases, CT of the face should be obtained to provide beneficial detailed information on the pattern of nasal and septal fractures and the extent of facial structures involved.
- Nasal fracture reductions should be performed in the controlled setting of an outpatient surgery center with IV sedation or a brief-acting general anesthetic to optimize results.
- To minimize nasal mucosal trauma, a Boise elevator should be used to reduce nasal bone fractures.
- Septal fractures need to be anatomically reduced to prevent long-term nasal deviations. Those that cannot be reduced adequately require submucous resection.
- The low incidence of revision is attributed to complete nasal assessment (bony and septal), fracture reduction using general anesthesia, and primary septal reconstruction in patients with severe septal fracture dislocations.

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Comprehensive Management of the Deviated Nose

Rod J. Rohrich ▪ Jack P. Gunter ▪ William P. Adams Jr.
Fadi C. Constantine ▪ Jamil Ahmad

The deviated nose is one that varies from the straight vertical orientation of the face. Correction of this deformity presents a challenge, because frequently a functional problem airway obstruction as well as an aesthetic issue must be addressed.[1-5] The anatomy of a deviated nose can involve asymmetries of the bony pyramid, a septal abnormality, or asymmetries of the upper and lower lateral cartilages, but usually involves some combination of these problems.[2,6-8] This can result in nasal airway obstruction without external deviation, external deviation without nasal airway obstruction, or external deviation with nasal airway obstruction. In addition, facial asymmetries add complexity to the analysis.

The causes of nasal deviation may be congenital or acquired from trauma or previous surgery. Severely injured noses represent a particularly difficult challenge for the rhinoplasty surgeon, involving both septal and bony asymmetries.[9] A major septal deformity is almost always a component of severely deviated noses.[10-13]

A major septal deformity is almost always a component of severely deviated noses.

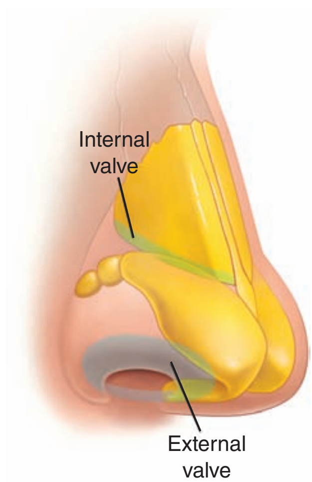
Adapted from Rohrich RJ, Gunter JP, Deuber MA, Adams WP Jr. The deviated nose: optimizing results using a simplified classification and algorithmic approach. Plast Reconstr Surg 110:1509-1523, 2002; and Constantine FC, Ahmad J, Geissler P, Rohrich RJ. Simplifying the management of caudal septal deviation in rhinoplasty. Plast Reconstr Surg (in press).

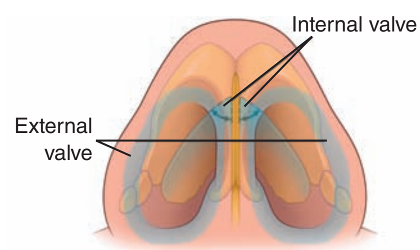
Attaining consistently good aesthetic and functional results when correcting the deviated nose requires a thorough understanding of nasal anatomy[14] and physiology, accurate preoperative analysis and intraoperative diagnosis, an understanding of the physiology of cartilage and its healing,[15-17] and the skill to precisely execute the surgical steps required to alter and control the nasal septum. If both septal and bony deviations are present, they are corrected during the same operation; it is not necessary to stage the correction of the deviated nose.

Straightening the septum is the key to achieving good functional and aesthetic results.

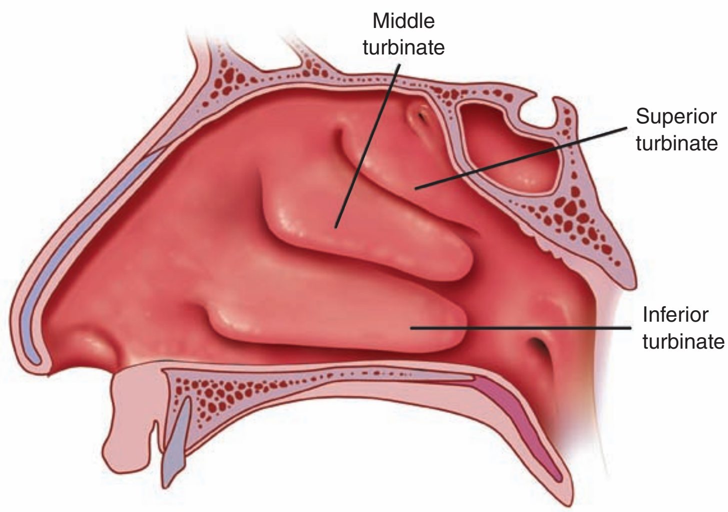
ANATOMY

A thorough understanding of normal nasal anatomy is a prerequisite for the surgeon achieving a good functional and aesthetic result.[18]





The nasal airway begins at the external nasal valve and is described as the region bounded medially by the septum and columella, laterally by the nasal ala and bony piriform aperture of the maxilla, and superolaterally by the caudal edge of the upper lateral cartilage. Just deep to this is the internal nasal valve, the narrowest portion of the normal nose. This is formed by the angle created between the caudal edge of the upper lateral cartilages and the dorsal septum. The nasal septum includes the quadrilateral cartilage, nasal spine, frontal spine, perpendicular plate of the ethmoid, vomer, and maxillary crest.



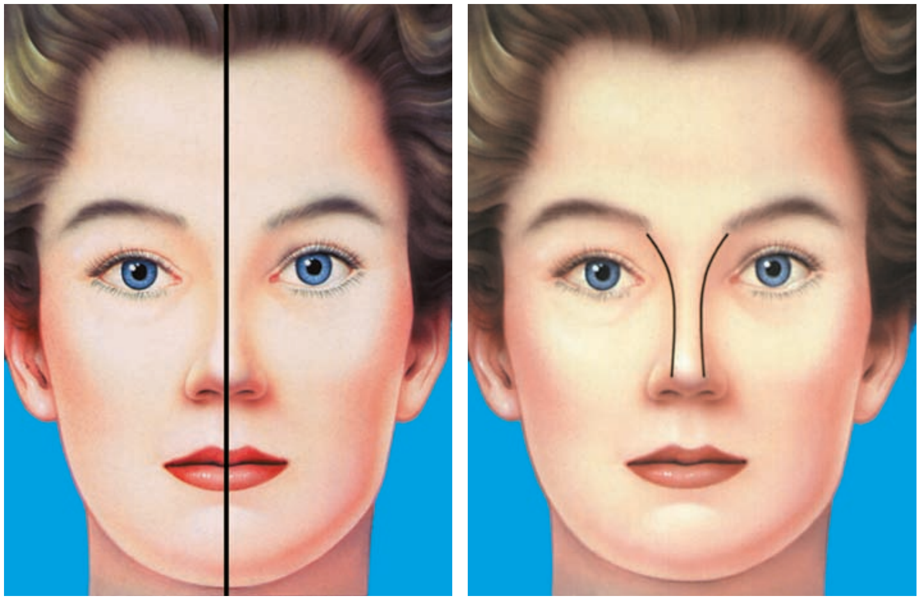
Parasagittal view of lateral nasal wall

Laterally, three or four turbinates are found (inferior, middle, superior, and sometimes, supreme), along with corresponding meatuses that drain the paranasal sinuses. The inferior turbinate is predominantly responsible for regulating airflow, whereas the middle turbinate humidifies the air.[19] The nasal airway is also bounded laterally by the upper lateral cartilages and the nasal bones. The nasal airway terminates at the choanae as the airflow passes into the nasopharynx.

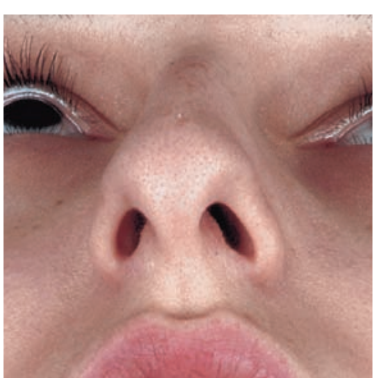
CLINICAL ASSESSMENT

Clinical analysis of the cause and anatomy of the nasal deviation is essential to planning corrective surgery. The deviated nose should be considered an osteocartilaginous unit in which all components potentially play a role. Critical components of the history include age, history of trauma, nasal airway complaints, allergies, and previous nasal surgery.

Critical components of the history include a history of nasal trauma, nasal airway complaints, allergies, and previous nasal surgery.



The external physical examination should include a systematic nasofacial aesthetic analysis, with emphasis on the deviation from the facial midline and the quality and shape of the dorsal aesthetic lines. The external examination concludes with an assessment of the shape and position of the nasal bones and the upper and lower lateral cartilaginous vaults.



Standard photography is always encouraged and is an important aspect of the secondary examination. Often, subtle asymmetries and deformities are more easily identified. The frontal view allows evaluation of the nasal asymmetries and its relationship to facial asymmetries. In some instances, nasal asymmetries are secondary to asymmetries of the facial skeleton and rhinoplasty will have a limited effect on fully correcting these.

The basal view is especially important for assessing caudal septal deviations and tip deviations. During the internal examination anterior septal deviations and the status of bilateral turbinates are assessed.

There are three basic types of nasal deviation, two of which have subtypes:

1. Caudal septal deviation
   Straight septal tilt
   S-shaped septal tilt
2. Concave deformity
   C-shaped dorsal deformity
   Reverse-C-shaped deformity
3. Concave/convex dorsal deformity

Nasal deviations can be classified into three basic types: the straight septal tilt off the vomer, the C-shaped and reverse C-shaped deformities (usually without bony pyramid deviation), and the S-shaped deformity involving a deviated bony pyramid.

Caudal septal deviations cause significant airway compromise because they affect the anteroinferior part of the external nares. Two subtypes are commonly seen. The first and most common is a straight septal tilt off the vomer with no dorsal septal curvature, exhibiting a caudal septal deviation pushing the nasal tip off the midline and without deviation of the nasal pyramid. The second subtype has a similar effect on the nasal tip but has an S-shaped curvature of the caudal septum that is more difficult to correct.

The second most common type is the concave deformity. The two subtypes are the C-shaped deformity with a left-sided concavity and the reverse C-shaped deformity with right-sided concavity. The least common type and most difficult to correct is the concave/convex deformity, also known as an S-shaped dorsal deformity with bony pyramid deviation.[20]

The goals of correction are both aesthetic and functional. The aesthetic goals include straightening the dorsum, correcting bony asymmetries, and defining the tip to enhance facial balance. Functionally, the goals are directed at improving the nasal airway, including straightening the septum, restoring the nasal valve integrity, and correcting any inferior turbinate hypertrophy.[9]

CAUSES OF NASAL DEVIATIONS

Significant intrinsic and extrinsic forces produce nasal deviation that result in septal distortion and deviation responsible for aesthetic and functional deformities.[21] The extrinsic forces are either secondary to scar contractures or congenitally asymmetrical attachments of the osteocartilaginous skeleton, including attachments between the bony pyramid, the upper lateral cartilages, the lower lateral cartilages, and the septum. The intrinsic forces are those acquired or that are inherent septal cartilaginous abnormalities. In patients who have experienced nasal trauma these are predominantly represented by septal fractures of the caudal-inferior, the cephalic-posterior septum, the horizontal septum, or the C-shaped central septal segment.[22,23]

Both intrinsic and extrinsic deforming forces are responsible for producing the aesthetic and functional deformity.

PRINCIPLES OF TREATMENT

Correction of the deviated nose is based on the eight principles described below.[1,2,20,24] As with all rhinoplasty procedures, accurate preoperative planning and diagnosis are essential to successful outcomes.

Wide Exposure of Deviated Structures

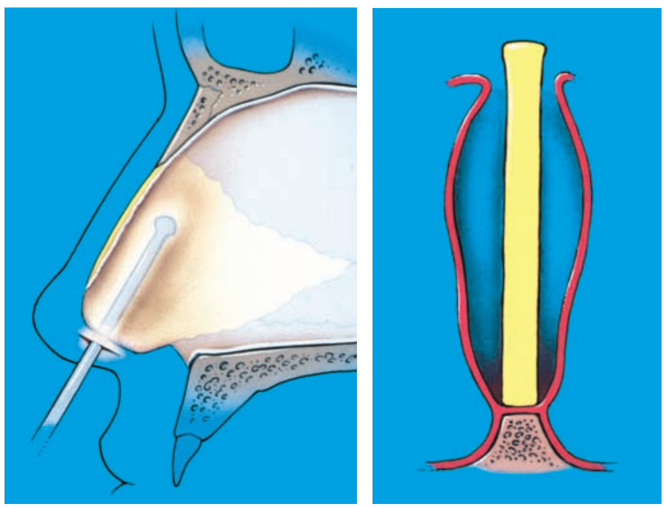
The open rhinoplasty approach is preferred for the management of the deviated nose, especially in patients with a high dorsal deviation. The exposure afforded by the open approach allows maximal accuracy in diagnosis and control in achieving optimal repair of the deviated nose.

The open rhinoplasty approach is preferred for correction of the deviated nose. The exposure afforded by the open approach allows maximal accuracy in diagnosis and control in achieving optimal repair of the deviated nose.

Any structure that is out of place must be released from all deforming extrinsic attachments and replaced in its correct anatomic position. If the nasal bones are deviated, osteotomies must be performed; if the upper lateral cartilages are displaced, they should be freed from the septum and the lower lateral cartilages. Deviated portions of the septum must be widely mobilized to return them to the midline.

All deviated structures should be widely released to allow replacement in the correct anatomic position.

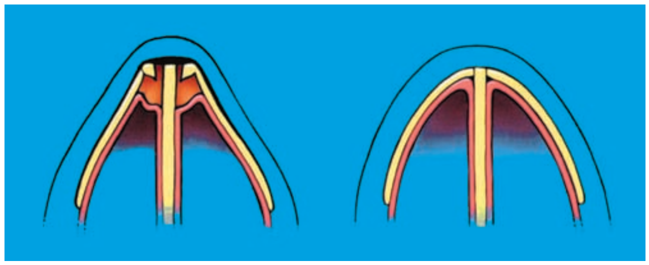
Wide Release of Mucoperichondrial Attachments



The mucoperichondrial attachments are conserved when possible to maintain the blood supply to the cartilage to minimize resorption. However, the mucoperichondrial attachments to a deviated portion of the septum must be widely released before the septum can be returned to the midline. A submucoperichondrial dissection is performed using a Cottle elevator, beginning at the anterior septal angle.

Mucoperichondrial attachments should be maintained whenever possible; however, they must be widely released from the deviated parts of the septum and osteocartilaginous skeleton.

After wide exposure, the extrinsic deforming forces are sequentially released. The lower lateral cartilages are freed from the upper lateral cartilages at the scroll area either through direct incision through the scroll area or with a cephalic trim, if necessary.



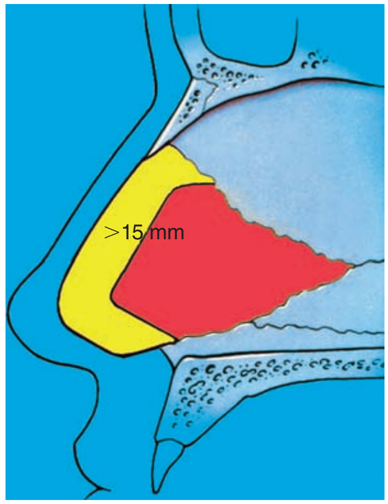
Bilateral mucoperichondrial tunnels are dissected deep to the upper lateral cartilages, and a scalpel is used to separate the upper lateral cartilages from the dorsal septum. If the deformity exists because asymmetrical upper lateral cartilages are causing extrinsic twisting of the septum, this maneuver will actually result in straightening of the septum. Once this has been done, the septum can be visualized to accurately assess any intrinsic septal causes of the deviation. In some cases, the septum will straighten after release of the mucoperichondrium if there are no intrinsic forces causing deviation of the cartilaginous or bony septum. In a patient with caudal septal deviation, the mucoperichondrium must be released all the way to the anterior nasal spine.

Intrinsic and extrinsic deforming forces must be completely released to achieve adequate correction.

Straightening the Deviated Septum and Septal Reconstruction

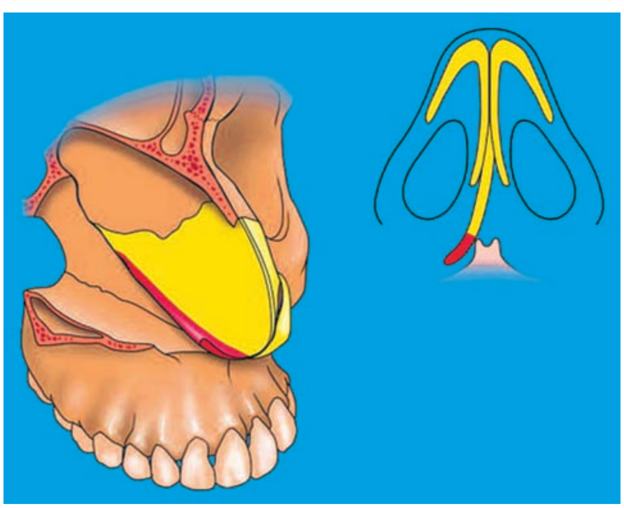
Once the deviated septum has been widely exposed and separated from the upper lateral cartilages, it must be straightened by addressing and correcting the intrinsic deforming forces. The goal is to straighten the septum while maximizing residual dorsal nasal support.

Straightening of the septum may involve repositioning to the midline or resection of the deviated portion.



Initially, the deviated portion should be resected, taking care to preserve at least 10 mm of an L-strut; however, this will depend on the strength of the septal cartilage and in many instances a width of 15 mm or more may be required to ensure long-term support. The resection may include the septal cartilage, maxillary crest, vomer, and perpendicular plate of the ethmoid. The L-strut should remain attached to the perpendicular plate at the keystone area and the anterior nasal spine and maxillary crest area. In addition, curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut, as well as between the dorsal and caudal L-strut, can help strengthen the construct.[2,20]

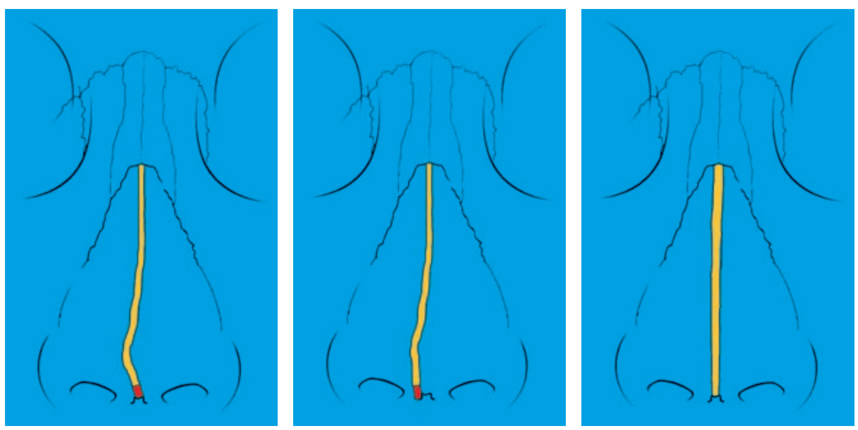
In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can add strength.



When deviated from the midline, the anterior two thirds and the inferior aspect of the septum posteriorly can affect nasal airflow significantly.[2,20] Anterior and inferior septal deviations tend to be poorly tolerated, because the cross-sectional area of the nasal airway is small compared to posterior in the nasal cavity.[21]

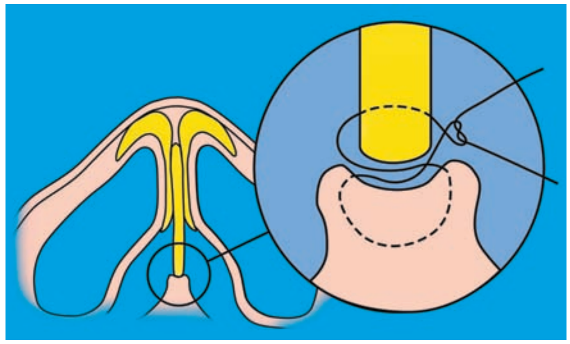
Septal reconstruction involves returning the deviated septum to the midline. The principle of cartilage preservation is paramount. Cartilaginous septum that is deviated or required for grafting should be removed. When addressing the bony septum, the septum can be microfractured and returned to the midline. In cases of C- or S-shaped craniocaudal deviation, there is vertical excess of the septum, and removing the inferior aspect of the septum allows microfracture of the remaining septum and return to the midline. Microfracture should be performed in a careful and controlled manner to avoid uncontrolled fractures into the superior nasal septum and cribriform plate. This is particularly important in posttraumatic cases where there may have been a prior septal fracture. Bony spurs of the septum can be removed using Takahashi forceps. Septal cartilage or bone should be removed with ease; if there is any resistance, residual soft tissue attachments should be completely released.

Correcting Caudal Septal Deviation



Once the posterior septum has been reconstructed, if there is a persistent caudal septal deviation, this is typically caused by vertical excess of the anterior septum. The caudal portion of the L-strut is disarticulated from the osteocartilaginous junction with the anterior nasal spine and maxillary crest. The degree of vertical excess is assessed and excised to allow the previously deviated septum to be returned to midline.

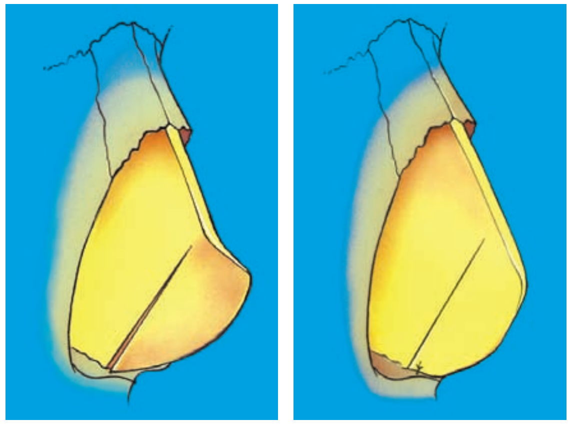
If there is a persistent caudal septal deviation, this is typically caused by vertical excess of the anterior septum. The caudal portion of the L-strut is disarticulated from the osteocartilaginous junction with the anterior nasal spine and maxillary crest. The vertical excess is excised to allow the previously deviated septum to be returned to midline.



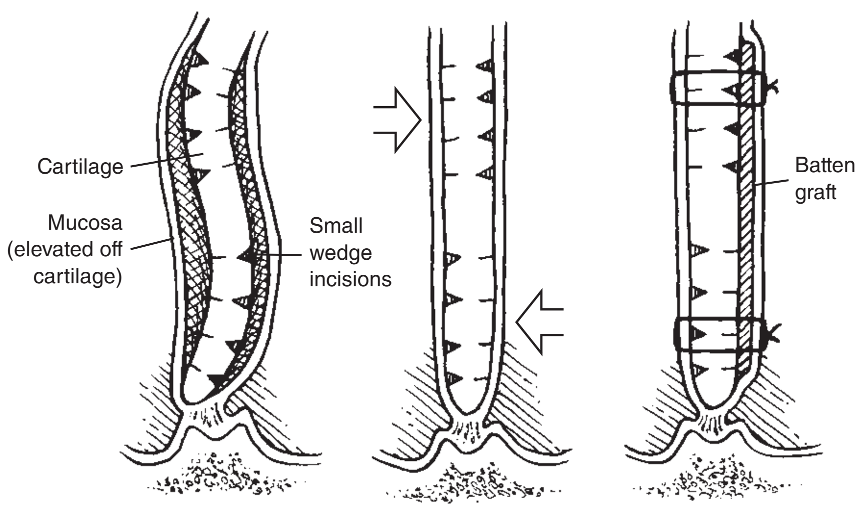
A 5-0 PDS suture is used to suture the caudal septum down to the periosteum of the contralateral aspect of the anterior nasal spine. When the anterior nasal spine is located away from the midline, it may be necessary to perform an osteotomy to the anterior nasal spine to return it to the midline or excise the anterior nasal spine and suture the septum down to the periosteum of the maxilla. Excessive resection of the anterior nasal spine can damage the anterior maxillary nerve and subsequently cause some upper lip numbness.

When extensive work has been done to the caudal septum, it is usually necessary to place several through-and-through horizontal mattress 5-0 chromic gut sutures in the caudal septum to re-approximate the caudal mucoperichondrial flaps to the midline. This allows the flaps to scar down in the midline position and provides extra long-term support.

Although these concepts and simplified approach to correction of caudal septal deviation have worked effectively in most cases, in some instances it is necessary to be more aggressive in correcting severe deformities of the anterior septum. Scoring or partial-thickness wedge excisions coupled with the application of splinting grafts may be required to establish a straight and stable L-strut. Similarly, deformities of the anterior septum stemming from previous fracture lines, such as sharp angulations or overlapping segments, also require more complex maneuvers to first weaken or divide the anterior L-strut and then reinforce or reconstruct the L-strut into a straight construct.



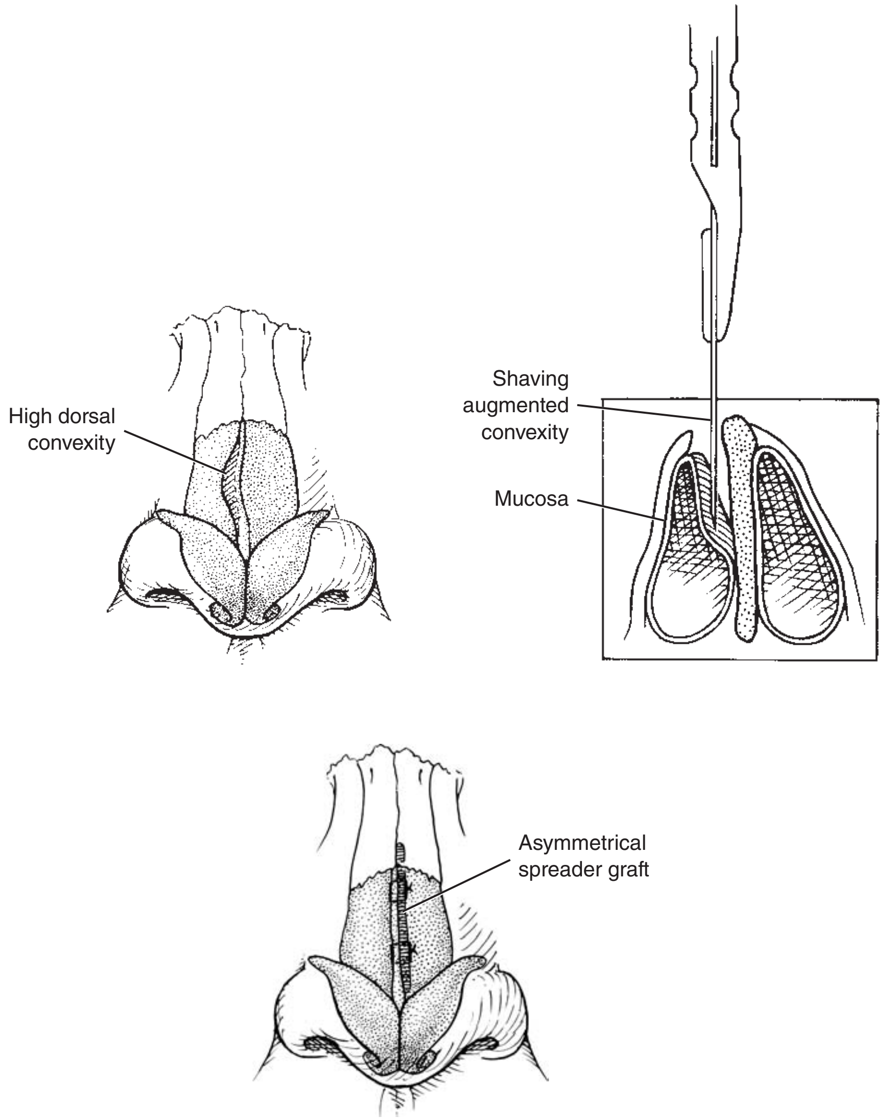
Straightening the septum may involve the development of a swinging door flap with a vertical wedge sectioning of the anterior septum at the point of caudal deviation.



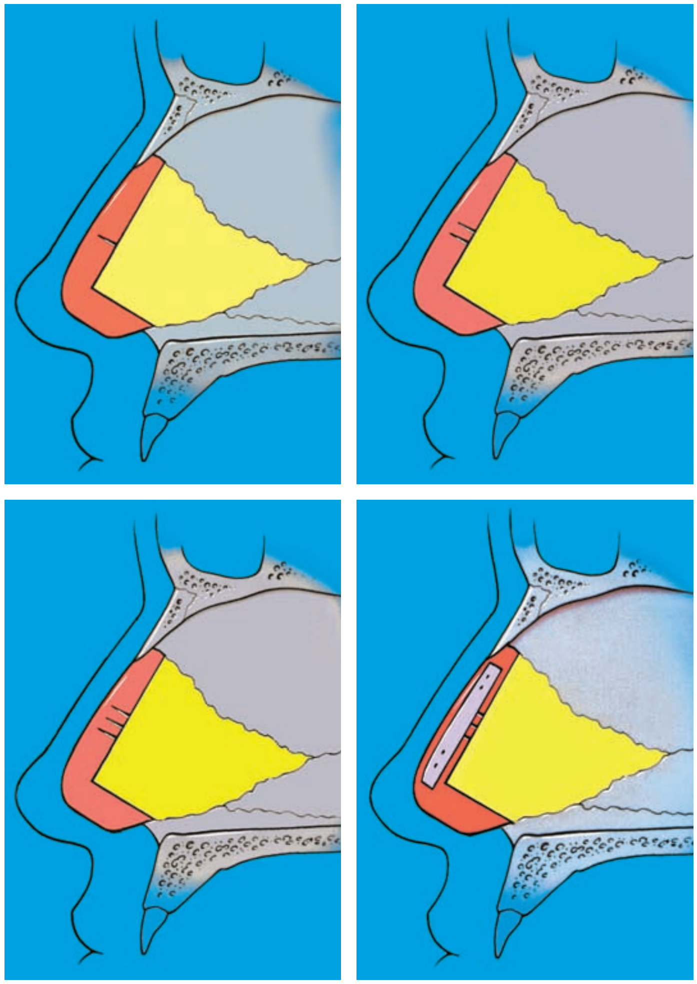
The severely deviated caudal septum requires the removal of small wedges of cartilage from the convex side, with scoring only of the opposite side to destroy cartilage memory and straighten the septum. Both swinging-door flap and wedge excision and scoring techniques often require batten grafts to support the straightened but weakened septum.

Other techniques such as splinting grafts, tongue-in-groove grafts, drill-hole fixation, or medial crural footplate excision may be necessary for adequate correction of severe caudal septal deviations. These techniques may require more cartilage than present in the septum and necessitate ear or rib cartilage harvest.

Correction of Dorsal Septal Deviation

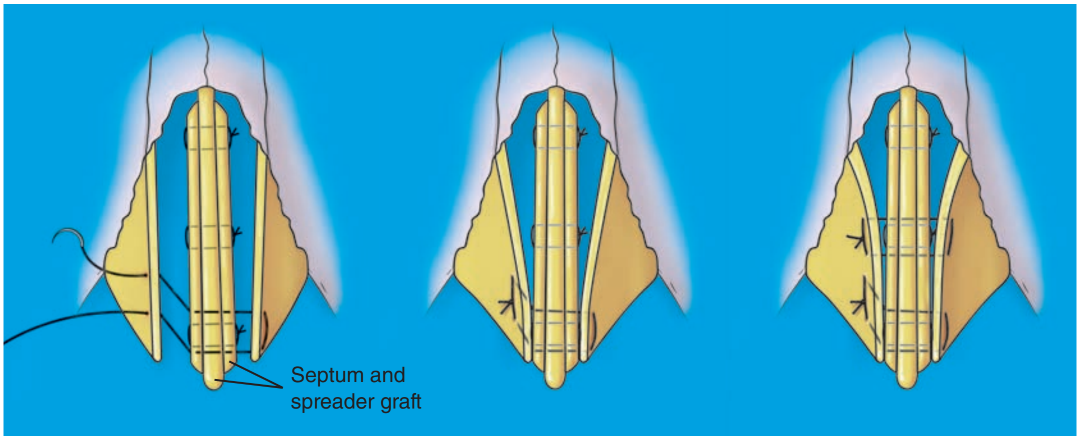


High dorsal deviations, if present, are corrected by shaving the convexity from the upper lateral cartilage on the side of the deviation; the residual deformity is camouflaged with an asymmetrical spreader graft. This combination will frequently be sufficient to correct minor C-shaped deformities of the dorsum. Cartilage-scoring techniques may be necessary to help straighten the more severe high dorsal deviation.



If a significant deformity persists despite these techniques, sequential inferior full-thickness cuts in the deviated portion of the dorsal septal cartilage are made up through 50% of the remaining dorsal L-strut. This will permit straightening of the deviated septum, but it will also weaken its support. Bilateral spreader grafts are needed to maintain support and restore the dorsal aesthetic lines.

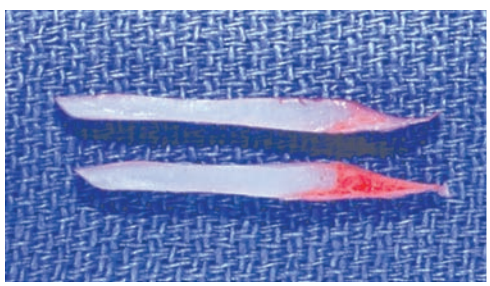
Sequential parallel inferior full-thickness cuts through 50% of the deviated portion of the remaining dorsal L-strut should be made for a high dorsal septal deviation to allow the septum to be straightened. However, this will result in long-term loss of support.



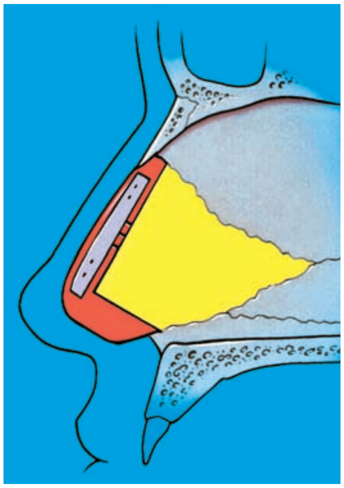
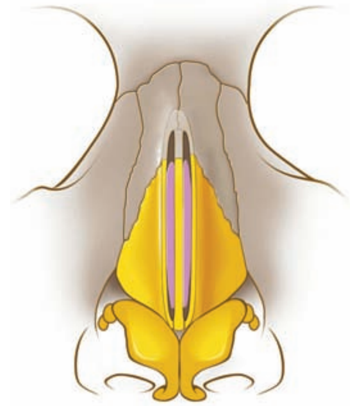
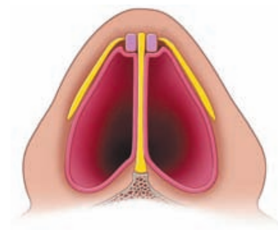
After the septum has been straightened, the upper and lower lateral cartilages are reassessed for symmetry. Any remaining asymmetries should be addressed by trimming and securing the upper lateral cartilages by suturing them to the dorsal septum before performing a lower lateral cartilage manipulation. Along the same lines, it may be necessary to perform clocking sutures from the upper lateral cartilage to the dorsal septum to help reposition the L-strut in the midline.[22]

Restoration of Septal Support

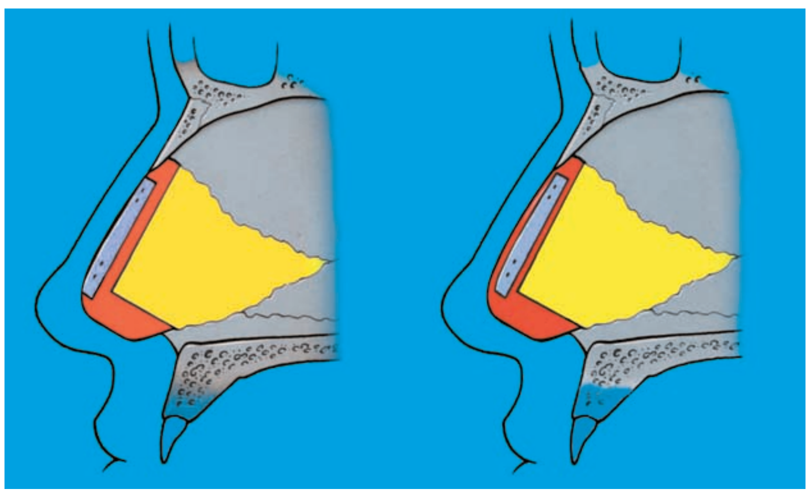
The height of the lower half of the nasal dorsum, the midvault, depends on the support of the septum.



Long-term support is restored by buttressing the weakened dorsal septum with spreader grafts.[23-27] The spreader grafts help to maintain or restore the integrity of the internal nasal valves, to restore the dorsal aesthetic lines, and to strengthen and maintain long-term septal support. These grafts are ideally fashioned from the posteroinferior portion of the septal cartilage, since it has the most consistent width and allows harvest of the 30 to 35 mm length required. They are contoured to be 4 to 6 mm in height.

The spreader grafts are secured with two or three 5-0 PDS mattress sutures either unilaterally or bilaterally parallel to the dorsal septum according to the deformity being addressed.



Asymmetrical (unilateral) placement will camouflage any residual deviation. Their position may be either visible at or above the dorsal septal plane or invisible below the septal plane, depending on whether widening of the midvault or elevation of the dorsum is desired.[27]

The spreader grafts help to maintain or restore the integrity of the internal nasal valves, to restore the dorsal aesthetic lines, and to strengthen and maintain long-term septal support.

Inferior Turbinate Surgery

Septonasal deviations are a normal variant in human anatomy and are commonly associated with airway problems. This may lead to compensatory contralateral inferior turbinate hypertrophy. Even if airway obstruction is not present preoperatively, septal straightening may lead to narrowing of the anterior airway if inferior turbinate hypertrophy is present.

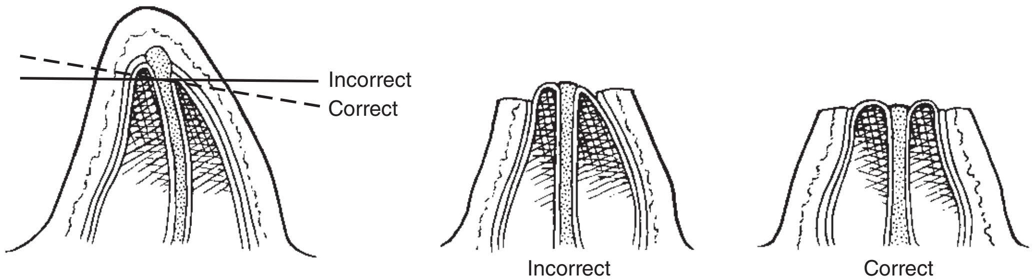
The hypertrophied inferior turbinates may subsequently interfere with septal repositioning and the postoperative airway. In most cases of mucosal hypertrophy, the inferior turbinate can be outfractured. In cases of bony hypertrophy, submucous microfracture and/or resection of the hypertrophied anterior inferior turbinate is performed to allow for an adequate postoperative airway.

Outfracture of the inferior turbinates is most often adequate to address inferior turbinate hypertrophy. Submucous microfracture and/or resection of the anterior inferior turbinate with resection of the hypertrophied bone may be necessary to maintain a straight septum and good nasal airway if inferior turbinate bony hypertrophy is present.

Nasal Osteotomies

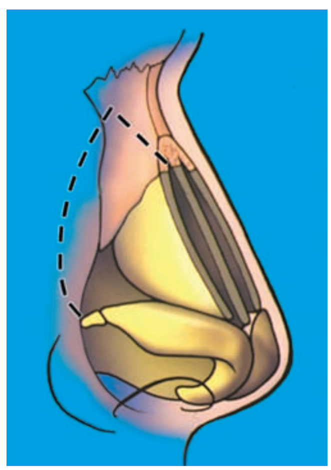
In correcting the deviated nose, nasal osteotomies are used to straighten and improve symmetry of both the superior dorsal aesthetic lines and the bony nose-cheek junction. Accurately planned lateral and/or medial nasal osteotomies will restore symmetry to the bony nasal pyramid. Before the surgeon performs osteotomies, the dorsal profile must be reassessed to determine whether dorsal reduction of the bony pyramid is necessary. If a bony dorsal hump must be resected, the orientation of the nasal bones must be considered, especially if there is asymmetrical bony deviation.

In correcting the deviated nose, nasal osteotomies are used to straighten and improve symmetry of both the superior dorsal aesthetic lines and the bony nose-cheek junction.

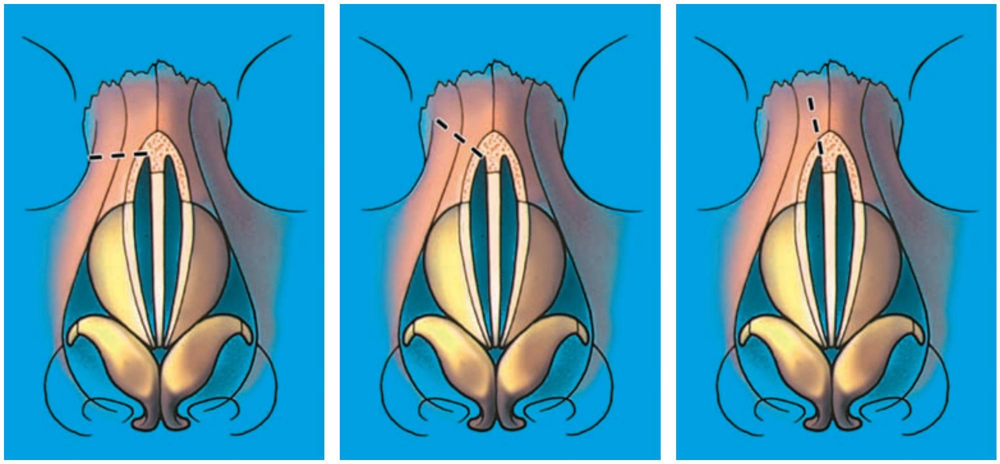


Less bone will need to be excised or rasped from the nasal bone on the deviated side that is more vertically oriented. This will prevent excessive reduction in nasal bone dorsal height of that side after the nasal bones are anatomically reduced.

For asymmetrical nasal bones, rasping must be done obliquely, taking care to perform less reduction on the side of the more vertically oriented bone so that the nasal bones are symmetrical after reduction with lateral osteotomies.



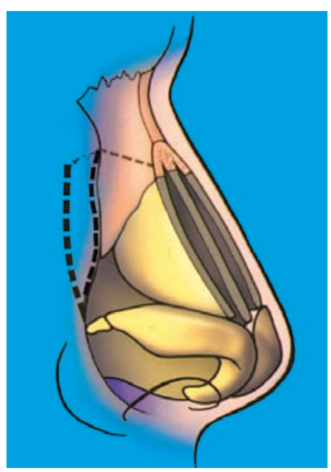
Lateral osteotomies alone will be sufficient only in the settings of bony pyramid deviation with symmetrical nasal bones or a significant open roof. They are performed in a percutaneous perforated fashion with a 2 mm osteotome.



Transverse Superior oblique Paramedian

Deviation with any significant degree of bony asymmetries will require medial osteotomies as well.[1,21] These medial osteotomies are required to allow independent movement of the nasal bones. If planned, medial osteotomies should be performed before the lateral osteotomies are done.

Medial osteotomies may be necessary in addition to lateral osteotomies for an asymmetrical nasal pyramid.



Double level

When nasal bone intrinsic convexity is present, double-level osteotomies will be necessary. The surgeon should be careful not to excessively free up the periosteum of the nasal bones, because comminution can result from multiple osteotomies and the periosteum can prevent the displacement of these comminuted fragments. Dorsal reduction and septal straightening should be addressed before

the osteotomies are performed while the nasal dorsum is still stable. The dorsal profile should be reassessed after osteotomies to ensure that repositioning on the nasal bones has not created any dorsal irregularity. Only minimal bony rasping and incremental cartilage incisions can be performed after the osteotomies.

The dorsal profile should be reassessed after the osteotomies are performed to ensure that repositioning on the nasal bones has not created any dorsal irregularity.

OPERATIVE TECHNIQUE

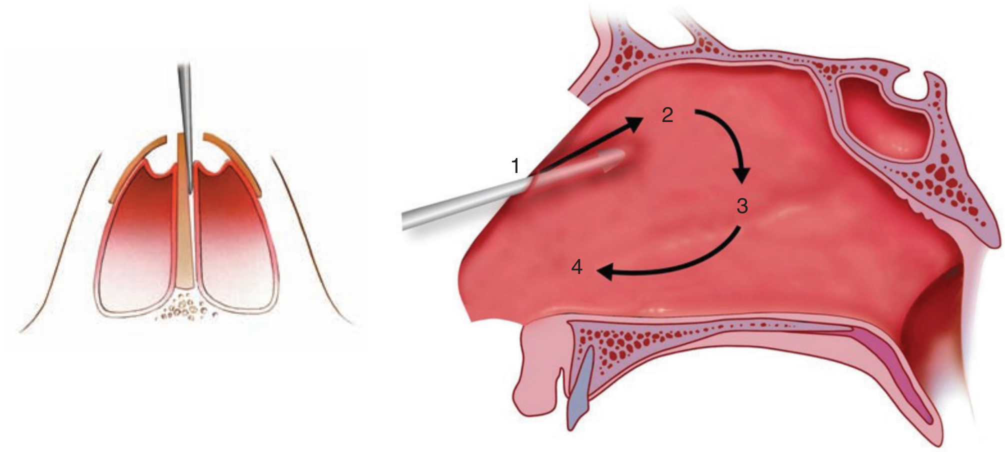
The osteocartilaginous skeleton is exposed using the open rhinoplasty approach, with a stair-step transcolumellar incision connected to bilateral infracartilaginous incisions. Elevation of the soft tissue off the osteocartilaginous framework should be limited to the central third of the bony vault. At the bony vault, only enough exposure should be performed to allow manipulation of the dorsum so that the lateral soft tissue attachments are preserved for bony stability if osteotomies are required.

A component dorsal approach to the dorsum is used. It involves the following:

1. Release of the upper lateral cartilages from the dorsal septum
2. Resection of the dorsal septum incrementally
3. Rasping of the bony dorsum
4. Restoration of the dorsal aesthetic lines

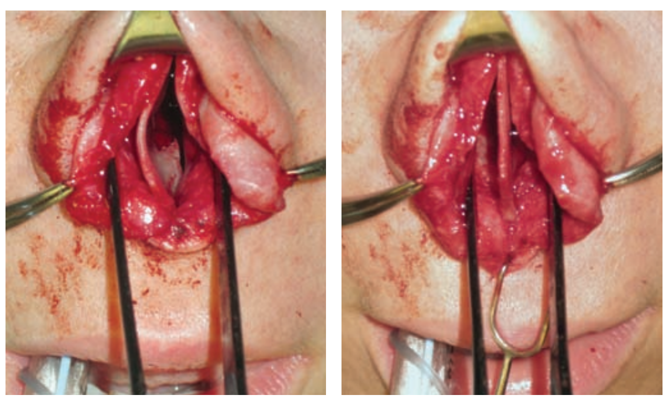
The septal mucoperichondrial flaps are elevated using the Cottle elevator beginning at the anterior septal angle. Bilateral mucoperichondrial tunnels are dissected deep to the upper lateral cartilages and then both are separated and mobilized from the dorsal septum. Any nasal dorsal reduction surgery required is now performed. If bony dorsal reduction is necessary, it is completed with the rasp. If the nasal bones are asymmetrical, rasping must be performed obliquely, taking care to reduce the side of the more vertically oriented bone to a lesser degree so that the nasal bones are symmetrical after lateral osteotomies.

When the nasal pyramid is asymmetrical, dorsal reduction must be done obliquely to prevent excess bone removal from the more vertically oriented side, which would become evident after anatomic repositioning of the nasal bones.



Septal reconstruction resection and cartilage graft harvesting are performed through a dorsal approach after the bilateral mucoperichondrial flaps are elevated posteriorly to expose the cartilaginous and, if necessary, the bony septum.

Posterior septal deviation is repositioned to the midline or removed, taking care to maintain at least a 10 to 15 mm L-strut dorsally and caudally; more should be left if possible. This resection may include the septal cartilage, maxillary crest, vomer, and perpendicular plate of the ethmoid.



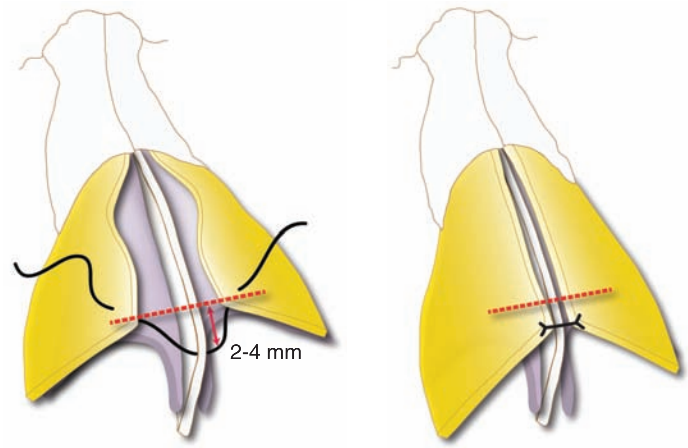
If the remaining anterior caudal septum is deviated off the anterior nasal spine and maxillary crest but does not have a dorsal deviation or vertical excess of the septum (straight septal tilt), it is anatomically reduced and secured in position with a figure-of-eight suture of 5-0 PDS to the periosteum of the contralateral nasal spine. If a significant intrinsic deviation is present, this is typically caused by vertical excess of the caudal septum. The caudal portion of the L-strut is disarticulated from the osteocartilaginous junction with the anterior nasal spine and maxillary crest. The degree of vertical excess is assessed and this is excised to allow the previously deviated septum to be returned to midline. A 5-0 PDS suture is used to suture the septum down to the periosteum of the contralateral aspect of the anterior nasal spine.

Inferior full-thickness parallel cuts through 50% of the dorsal L-strut are made to correct the high dorsal deviation. Any remaining cartilaginous asymmetries are now addressed by trimming the upper lateral cartilages and/or performing lower lateral cephalic trims.

If required, spreader grafts are fashioned from the harvested septum and contoured to 4 to 6 mm in height and 30 to 32 mm in length. They are secured to the L-strut with at least two 5-0 PDS horizontal mattress sutures to restore support and internal nasal valve integrity. These are placed below the septal plane in an invisible position if midvault widening is not indicated or desired. Asymmetrical spreader grafts may be used if necessary to camouflage any residual deformity to accurately restore the dorsal aesthetic lines.

To restore septal support, spreader grafts 4 to 6 mm in height and 30 to 32 mm in length should be secured to the dorsal septum with at least two 5-0 PDS sutures. These will also maintain the integrity of the internal nasal valves and if placed asymmetrically will camouflage any residual septal deviation. Dorsal aesthetic lines will be restored to normal.

In some cases, correction of the deviated nose does not require spreader grafts. Instead, autospreader flaps may be used to both camouflage any residual concavity of the dorsal septum and restore the internal valve. Additionally, clocking sutures can be placed to the autospreader flap to control residual septal deviations.



If the dorsal septum remains straight without the use of spreader grafts or autospreader flaps, then the midvault and dorsal aesthetic lines should be restored using upper lateral cartilage tension-spanning sutures.

The inferior turbinates are now assessed. If hypertrophy of the anteroinferior turbinate is present, we perform outfracture or a limited submucous microfracture and/or resection of the hypertrophied bone anteriorly.

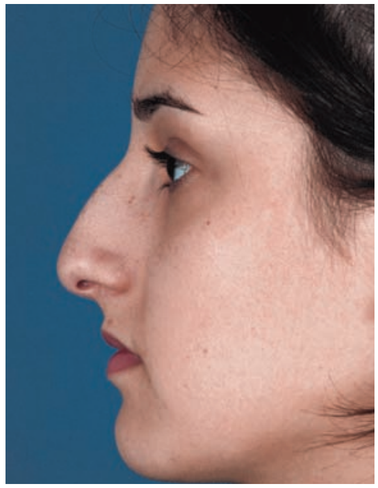
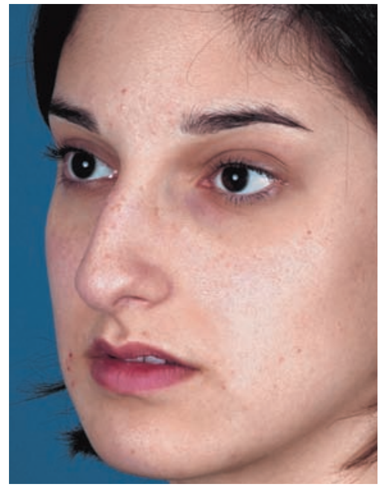
If a bony pyramid deviation is present, percutaneous perforated osteotomies are performed using a 2 mm osteotome. In general, lateral osteotomies are performed, but medial osteotomies will be necessary in the absence of an open roof or in the presence of asymmetrical nasal bones that must be moved independently. For convex deformities of individual nasal bones, double-level osteotomies are performed. The periosteum is preserved as much as possible so that displacement of any fragments does not occur in the event of comminution. The dorsum should be reevaluated after osteotomies to ensure no dorsal irregularities were produced.

If bony pyramid deviation is present, precisely planned osteotomies should be performed using percutaneous perforated nasal osteotomies. These may include lateral osteotomies, medial osteotomies, or double-level osteotomies if intrinsic nasal bone deviation is present.

Final tip refinement and alar support is then performed, followed by skin redraping, meticulous closure, and standard internal and external splinting.

It is important for the nose to be straight before completion of the rhinoplasty and closure.

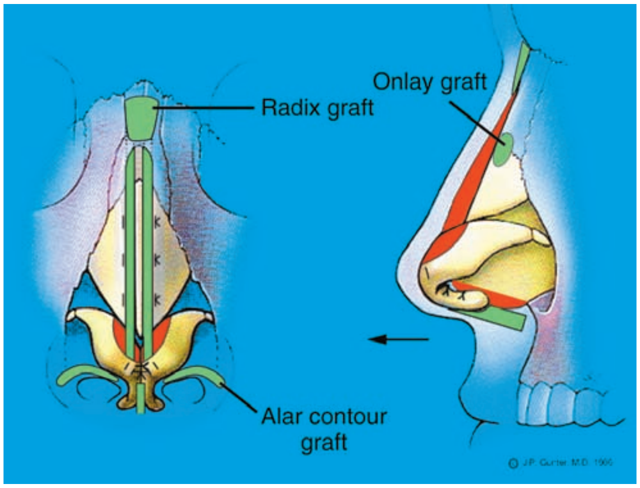
CASE ANALYSES

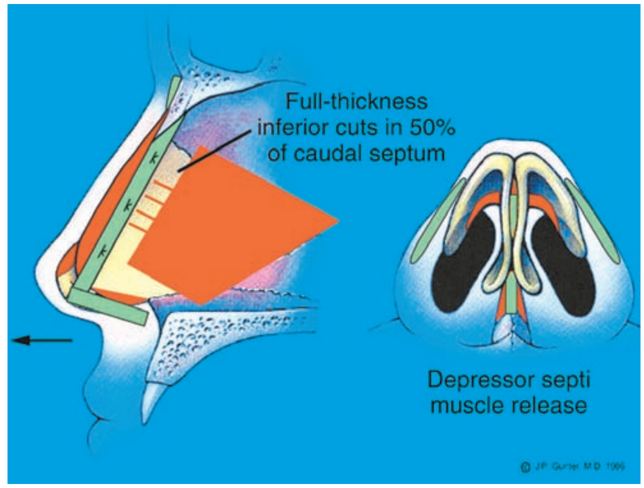





This 19-year-old primary rhinoplasty patient had a history of a deviated nose and nasal airway obstruction. She had a high C-shaped dorsal septal deviation and a bulbous tip with short nasal bones and thin skin. She requested functional and aesthetic improvement. The frontal view best demonstrates the short nasal bones with the C-shaped deformity, narrow midvault, and dorsal aesthetic lines that are disrupted in the keystone area. The patient's thin skin showed bifidity as well as excess in infratip projection, with periapical hypoplasia. On the lateral view the patient exhibits a low radix with a prominent dorsal cartilaginous hump, short upper lip, a slight excess tip projection, and normal nasal length. The nasolabial angle was 105 degrees. The basal view confirmed the caudal septal and nasal tip deviation to the right.

The operative goals included the following:

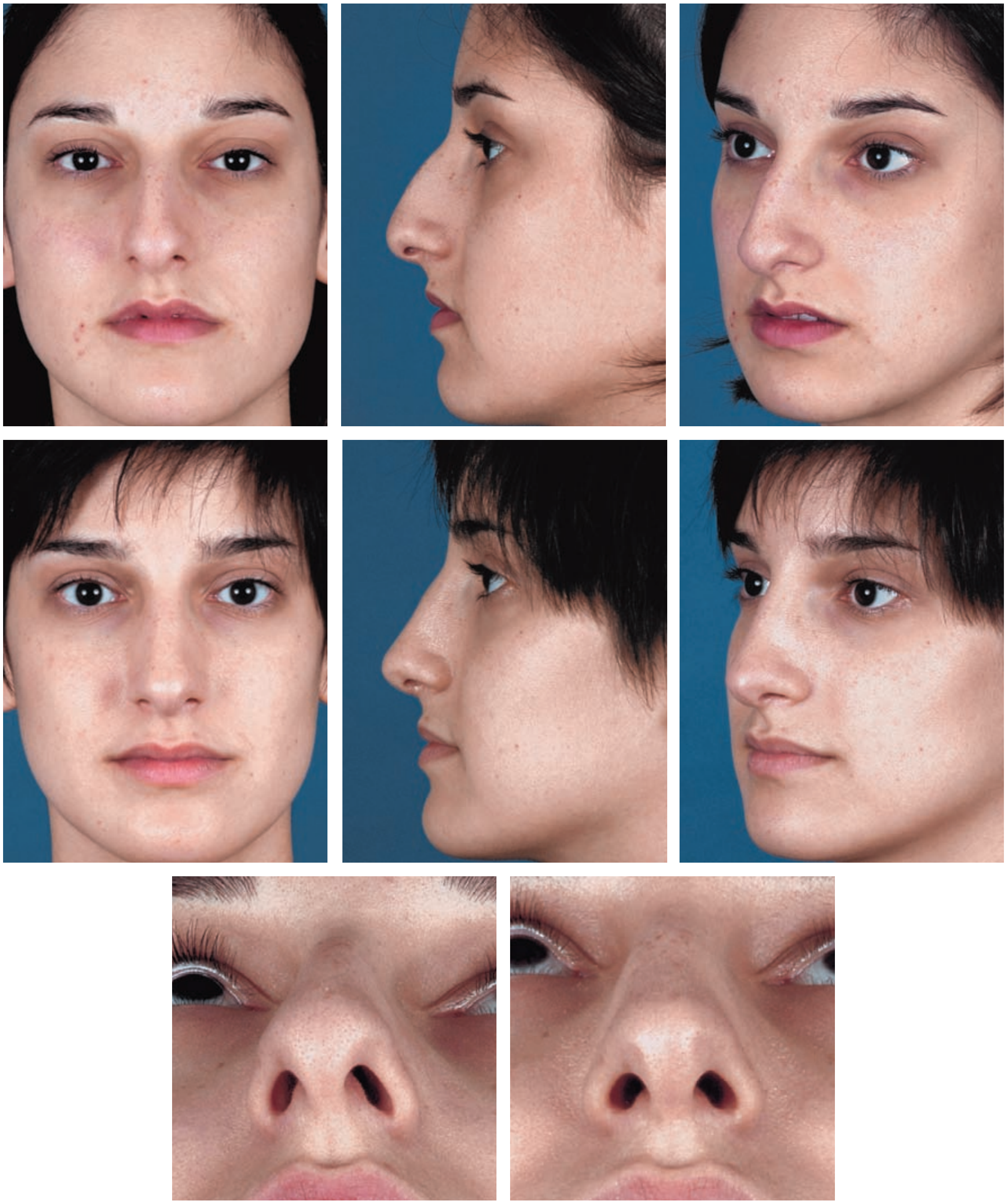
- Correct the dorsal deviation.
- Redefine and widen the dorsal aesthetic lines.
- Redirect the dorsal hump and straighten the nose.
- Refine the nasal tip.
- Correct the nasal airway obstruction.
- Release and transpose the depressor septi muscle to lengthen the upper lip.





Surgical Plan

1. Use an open approach.
2. Perform component dorsal hump reduction.
3. Perform septal reconstruction and harvest septal graft.
4. Make inferior full-thickness cuts in 50% of the L-strut.
5. Place bilateral spreader grafts to widen the dorsum after separation of the upper lateral cartilage from the septum.
6. Augment the radix by 5 mm with morselized cartilage graft.
7. Reconstruct the tip with a columellar strut graft secured with intercrural sutures.
8. Place interdomal and transdomal sutures as well as an infratip cap graft to correct bifidity.
9. Place a left dorsal onlay graft to correct the irregularity of the left osteocartilaginous vault.
10. Dissect and transpose the transoral depressor septi nasi muscle.
11. Resect the caudal septum 3 mm and secure with 5-0 PDS sutures to the periosteum of the anterior nasal spine.
12. No nasal osteotomies required.
13. Place bilateral alar contour grafts to correct alar weakness.

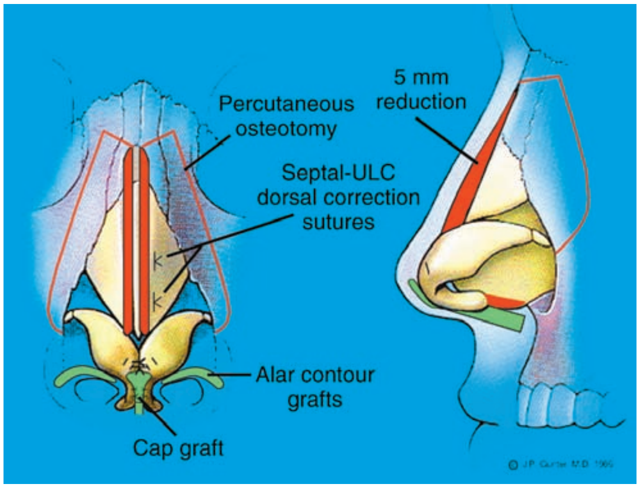


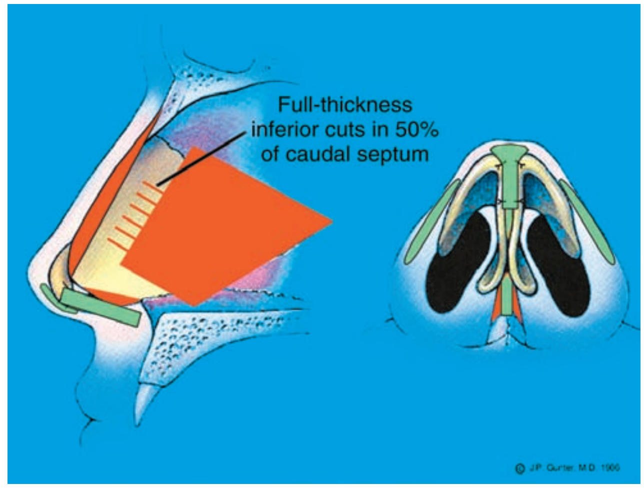
The patient is shown 2 years postoperatively. Note the straight nasal dorsum with balanced dorsal aesthetic lines. The bulbous tip has been corrected and infratip lobular projection improved. The lateral view reveals a normal radix with normal length and projection and improved nasal infratip lobular area. The nasolabial angle is now 95 degrees and the dorsum is straight. The oblique view demonstrates correction of the high midvault dorsal deviation and bulbous tip. The basal view shows the improved columellar-tip relationship and symmetry of the external nares.

This 55-year-old man complained of his large nose, excessive nasal length and tip projection, and a crooked dorsal hump. He had Fitzpatrick type II thin skin, a reverse C-shaped dorsal deviation, a long nose, and a bulbous tip. The lateral view best demonstrates the long nose with excess dorsal convexity, excess tip projection, and a high radix with a significant reversed C-shaped deformity. The nasolabial angle measured 95 degrees. The oblique view reveals the dorsal convexity and excess nasal length and deviation. The basal view shows the dorsal convexity deviating the nose to the right, the bulbous tip, and the bilateral alar collapse (more on the right than the left) with deviation of the nose caudally into the left nostril.

The operative goals included the following:

- Reduce nasal length and tip projection.
- Reduce the dorsal hump.
- Refine the nasal tip.
- Correct the dorsally deviated dorsum.
- Narrow the bony nasal base.
- Prevent alar collapse.

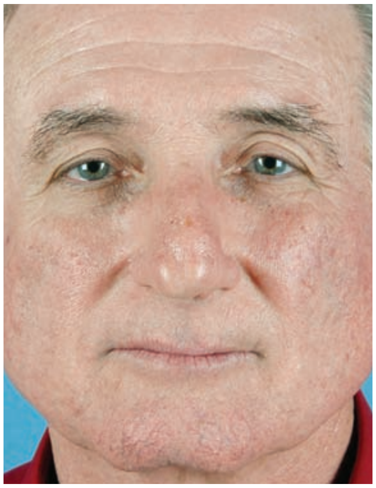
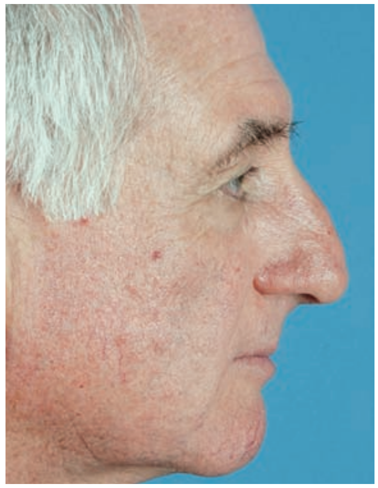
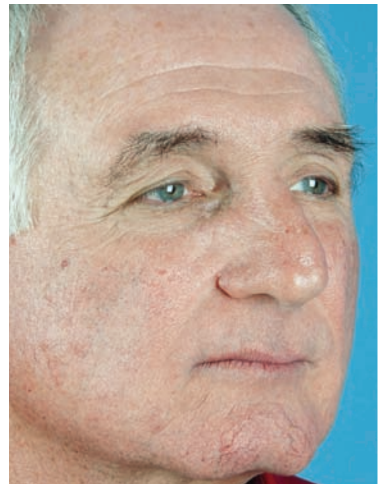




Surgical Plan

1. Use an open approach.
2. Expose the dorsal framework and reduce the dorsal hump.
3. Perform septal reconstruction and septal harvest.
4. Make inferior full-thickness cuts through 50% of the septum caudal to the deviated part of the septum, proceeding distally.
5. Suture the septum with 5-0 PDS horizontal mattress sutures to the upper lateral cartilage to maintain the dorsal correction.
6. Secure a columellar strut graft with intercrural sutures.
7. Use interdomal and transdomal sutures to refine the nasal tip.
8. Place bilateral alar contour grafts to correct alar notching.
9. Reduce the caudal septum 3 mm and suture with 5-0 PDS to the anterior nasal spine to straighten the caudal septum.
10. Perform bilateral lateral percutaneous perforated nasal osteotomies to narrow the nasal base (low-to-low).

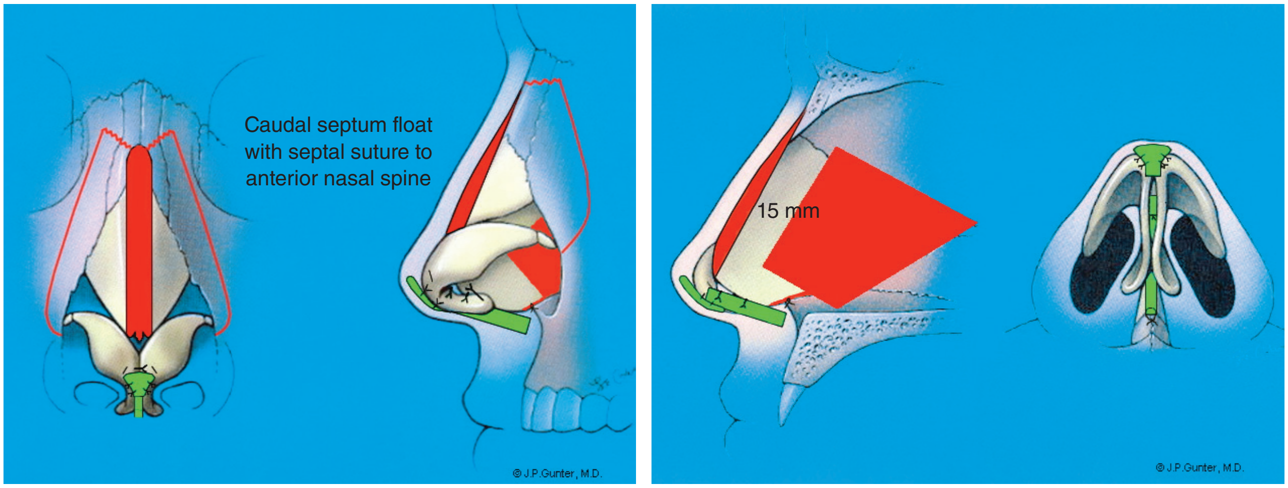
The patient is shown 9 months postoperatively with a straight nose and improved nasofacial balance. The nasal length and tip projection are appropriate. Note the straight dorsum and improved dorsal aesthetic lines on the oblique and lateral views. The basal views reveal correction of alar notching. However, slight fullness of the left caudal septum persists; palpation shows this to result from soft tissue at the feet of the crura that has retained memory from the long-standing septal deviation.


This 60-year-old primary rhinoplasty patient presented with a crooked nose and nasal airway obstruction. The frontal view shows his asymmetrical dorsal aesthetic lines and large, asymmetrical, ill-defined tip. On the lateral view the patient exhibited a prominent dorsal hump and supratip fullness. The basal view best reveals the severe caudal septal deviation into the left nostril with flaring of the left medial crural footplate obscuring a significant portion of the external nasal valve. His boxy tip is also evident on the basal view.

The operative goals included the following:

- Correct the dorsal and caudal septal deviation.
- Redefine the dorsal aesthetic lines.
- Reduce the dorsal hump.
- Refine the nasal tip.
- Correct the nasal airway obstruction.



Surgical Plan

1. Use an open approach.
2. Perform component dorsal reduction.
3. Perform septal reconstruction and septal harvest.
4. Perform inferior turbinate submucous resection and outfracture.
5. Disarticulate the caudal L-strut from the anterior nasal spine and maxillary crest, shorten the vertical excess, and suture with 5-0 PDS to the contralateral anterior nasal spine.
6. Secure a columellar strut graft with intercrural sutures.
7. Use interdomal and transdomal sutures to refine the nasal tip.
8. Place an infratip graft to improve tip definition.
9. Perform bilateral lateral percutaneous perforated nasal bone osteotomies to narrow the nasal base (low-to-low).

The patient is shown 2 years postoperatively. Note the straight nasal dorsum, with balanced dorsal aesthetic lines and increased tip definition. The basal view shows the marked improvement in the caudal deviated septum. His nasal airway obstruction was significantly improved.

KEY POINTS

- A major septal deformity is almost always a component of severely deviated noses.
- Straightening the septum is the key to achieving good functional and aesthetic results.
- Critical components of the history include a history of nasal trauma, nasal airway complaints, allergies, and previous nasal surgery.
- Nasal deviations can be classified into three basic types: the straight septal tilt off the vomer, the C-shaped and reverse C-shaped deformities (usually without bony pyramid deviation), and the S-shaped deformity involving a deviated bony pyramid.
- Both intrinsic and extrinsic deforming forces are responsible for producing the aesthetic and functional deformity.
- The open rhinoplasty approach is preferred for correction of the deviated nose. The exposure afforded by the open approach allows maximal accuracy in diagnosis and control in achieving optimal repair of the deviated nose.
- All deviated structures should be widely released to allow replacement in the correct anatomic position.
- Mucoperichondrial attachments should be maintained whenever possible; however, they must be widely released from the deviated parts of the septum and osteocartilaginous skeleton.
- Intrinsic and extrinsic deforming forces must be completely released to achieve adequate correction.
- Straightening of the septum may involve repositioning to the midline or resection of the deviated portion.
- In many instances, the width of the dorsal and caudal L-strut should be 15 mm or more to ensure long-term support. Curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and between the dorsal and caudal L-strut can help add strength.
- If there is a persistent caudal septal deviation, this is typically caused by vertical excess of the anterior septum. The caudal portion of the L-strut is disarticulated from the osteocartilaginous junction with the anterior nasal spine and maxillary crest. The vertical excess is excised to allow the previously deviated septum to be returned to midline.
- Sequential parallel inferior full-thickness cuts through 50% of the deviated portion of the remaining dorsal L-strut should be made for a high dorsal septal deviation to allow the septum to be straightened. However, this will result in long-term loss of support.
- The spreader grafts help to maintain or restore the integrity of the internal nasal valves, to restore the dorsal aesthetic lines, and to strengthen and maintain long-term septal support.

- Outfracture of the inferior turbinates is most often adequate to address inferior turbinate hypertrophy. Submucous microfracture and/or resection of the anterior inferior turbinate with resection of the hypertrophied bone may be necessary to maintain a straight septum and good nasal airway if inferior turbinate hypertrophy is present.
- In correcting the deviated nose, nasal osteotomies are used to straighten and improve symmetry of both the superior dorsal aesthetic lines and the bony nose-cheek junction.
- For asymmetrical nasal bones, rasping must be done obliquely, taking care to perform less reduction on the side of the more vertically oriented bone so that the nasal bones are symmetrical after reduction with lateral osteotomies.
- Medial osteotomies may be necessary in addition to lateral osteotomies for an asymmetrical nasal pyramid.
- The dorsal profile should be reassessed after the osteotomies are performed to ensure that repositioning on the nasal bones has not created any dorsal irregularity.
- When the nasal pyramid is asymmetrical, dorsal reduction must be done obliquely to prevent excess bone removal from the more vertically oriented side, which would become evident after anatomic repositioning of the nasal bones.
- To restore septal support, spreader grafts 4 to 6 mm in height and 30 to 32 mm in length should be secured to the dorsal septum with at least two 5-0 PDS sutures. These will also maintain the integrity of the internal nasal valves and if placed asymmetrically will camouflage any residual septal deviation. Dorsal aesthetic lines will be restored to normal.
- If bony pyramid deviation is present, precisely planned osteotomies should be performed using percutaneous perforated nasal osteotomies. These may include lateral osteotomies, medial osteotomies, or double-level osteotomies if intrinsic nasal bone deviation is present.
- It is important for the nose to be straight before completion of the rhinoplasty and closure.

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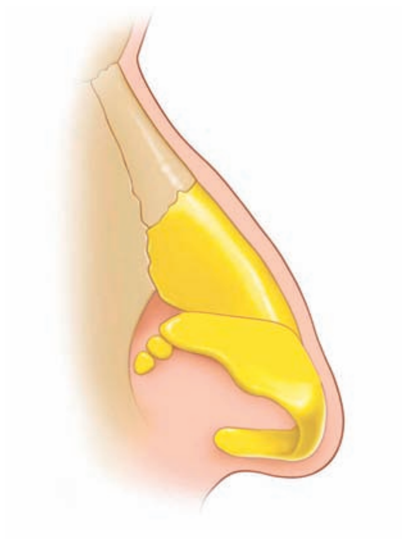
PART TEN

Special Topics and Advances



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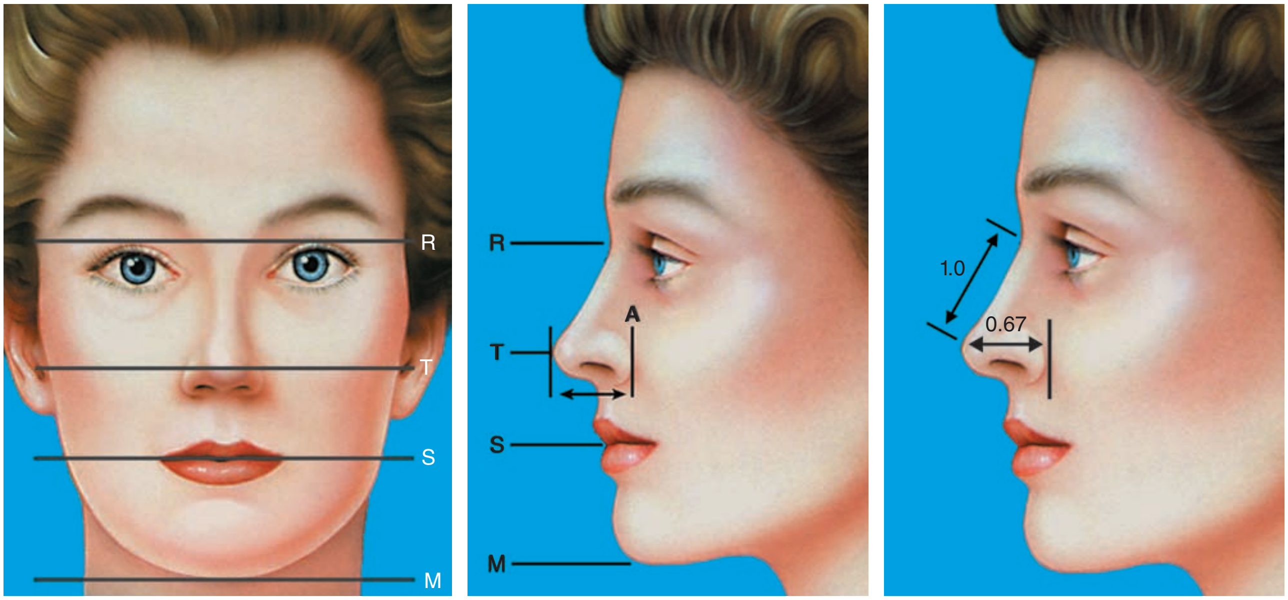
Surgical Correction of the Long Nose

Rod J. Rohrich ▪ Purushottam A. Nagarkar ▪ Jamil Ahmad

From the earliest days of aesthetic rhinoplasty, the abnormally long nose has been identified as a deformity requiring correction. In 1898 Joseph presented a method of correcting a nose with excess length and tip projection, as well as a dorsal hump.[1] Several decades later, Joseph published his seminal book, *Nasenplastik und sonstige Gesichtsplastik* (Rhinoplasty and Other Plastic Surgery), in which he presented several etiologic factors associated with a long nose and the attendant methods for correcting it.[2] Since then more anatomic details have been discovered, and a vast array of surgical procedures now exists for correction of the long nose. In this chapter we present an overview of the long nose deformity, including preoperative nasal analysis, the current understanding of the anatomic causes of this deformity, and its surgical management.

PREOPERATIVE CLINICAL ANALYSIS

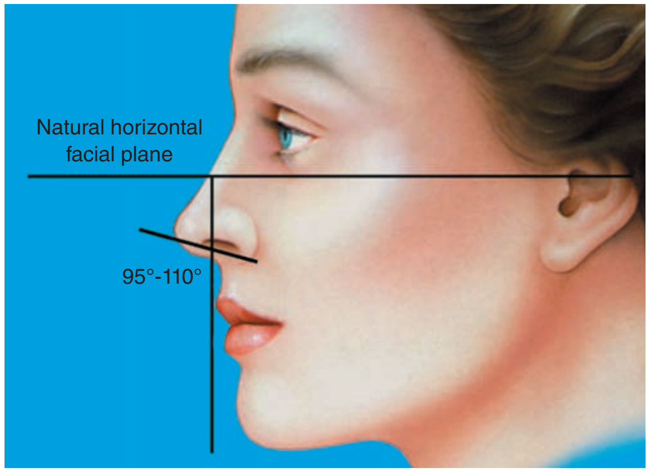
The importance of preoperative systematic nasal analysis cannot be overemphasized. Standardized photographs that are reproducible postoperatively (see Chapter 5), combined with objective analysis, are essential to a good operative plan and assessment of the postoperative result. Regardless of the exact method used, it is important that the parameters used to guide the nasal analysis be precisely defined. Ideal nasal proportions must be defined in terms of other facial features (since the overall size of the face will vary from person to person). Therefore any assessment of nasal length must first ask: Is the nasal length abnormal, or are the surrounding features abnormal? The surgeon must use his or her aesthetic judgment to determine which features will form the foundation for the relative nasal proportions and base further assessments on these.



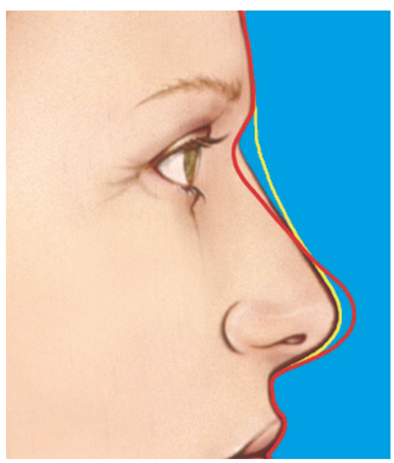
Nasal length is defined as the distance from the root of the nose *(R)* to the tip *(T)*. Byrd and Hobar[3] stated that the nasal root must be differentiated from the radix breakpoint, since the radix can be abnormally located (and therefore be a cause of an abnormal nasal length). The point at the nasal root *(R)* on the midline of the nasal dorsum is in the same horizontal plane as the superior palpebral fold (or 6 mm above the medial canthus in cases where the fold is abnormally located). The point at the nasal tip *(T)* is the point on the midline of the nasal tip at the tip-defining point of the lower lateral cartilages.

In a proportional and balanced face, the ideal nasal length *(RTi)* is 0.67 × the midfacial height *(MFH)* (distance from the glabella to the alar base plane), and equal to the distance from the stomion to the menton *(SM)*. The *RTi* is also related to nasal projection *(AT);* ideal nasal projection is 0.67 × the nasal length.

Nasal length is defined as the distance from the root of the nose to the tip.



The perception of nasal length can differ significantly from the actual measured nasal length. Abnormalities in other nasal or midface features can affect the perception of nasal length. The nasolabial angle can significantly affect the perception of nasal length; Daniel[4] noted that an acute nasolabial angle can create the illusion of a long nose. Similarly, an overly obtuse nasolabial angle can make the length of a long nose appear to be less, and the problem will only become apparent once the nasolabial angle has been corrected. The ideal nasolabial angle is higher in women (95 to 110 degrees) than in men (90 to 95 degrees).



Similar perceptual effects on the nasal length will be seen with changes in radix position and projection, tip projection, and so on. If the nose appears long because of a high radix, deepening of the radix will provide a shortened appearance.

CAUSES OF A LONG NOSE

There are four main etiologic factors associated with a long nose: congenital, traumatic, iatrogenic, and aging. As mentioned earlier, nasal length depends on several other nasofacial measurements. Assessing these relationships will help the surgeon identify the underlying abnormal anatomy and guide surgical treatment.

Cartilaginous Septal Overgrowth

Cartilaginous septal overgrowth has long been recognized as a cause of an excessively long nose.[2] Overgrowth of the cartilaginous septum is a common feature of the long nose and generally causes overprojection of the nasal tip; it has a variable effect on tip rotation. The lower lateral cartilages, which are attached to the septum by fibrous connections, are anteriorly displaced.[5] Tardy et al[12] categorized patients with septal overgrowth based on location of hypertrophy—dorsal or caudal.[6] If the septal overgrowth is more dorsal, the lower lateral cartilages tend to be displaced inferiorly, leading to a more acute columellar-labial angle. Conversely, if the overgrowth is more caudal, the lower lateral cartilages are superiorly displaced, with a resultant increase in the columellar-labial angle. Caudal septal overgrowth is generally accompanied by a short upper lip and increased incisor show.

Overgrowth of the cartilaginous septum is a common feature of the long nose and generally causes overprojection of the nasal tip; it has a variable effect on tip rotation.

Inadequate Tip Support

Inadequate tip support is probably the most common cause of the long nose. A lack of tip support will result in the unopposed effects of gravity on the tip, leading to descent of the tip and a decrease in tip rotation and tip projection. Constantian[7] noted that restoring tip support can decrease nasal length. Accompanying features in these patients may include an underprojected nasal tip, acute columellar-labial angle, pronounced and visible anterior septal angle, and a convex nasal dorsum profile. Congenitally weak lower lateral cartilages and weak fibrous connections between the upper lateral cartilages and lower lateral cartilages as well as between the domes of the lower lateral cartilages can lead to this constellation of findings. Loss of maxillary and periapical volume can also deproject the nasal tip.[8] This is seen in cases of maxillary hypoplasia or as a secondary finding in patients who have undergone cleft palate repair. Similarly, nasal

trauma can injure the caudal septum. If the quadrangular cartilage is unseated from the anterior nasal spine or maxillary crest or it is fractured, tip support can be lost. Bony loss at the nasal base or retrodisplacement of the nasal base will decrease tip projection.

Inadequate tip support is likely the most common cause of the long nose. A lack of tip support will result in the unopposed effects of gravity on the tip, leading to descent of the tip and a decrease in tip rotation and tip projection.

Prior rhinoplasty that excessively destabilizes the tip support mechanisms can also lead to the same findings.[9] Any approach to rhinoplasty is likely to weaken the nasal tip support structures to some degree. In general, nasal tip support structures are profoundly weakened or totally disrupted in both cartilage delivery and intracartilaginous approaches to primary rhinoplasty.[6] To avoid this complication, it is imperative to minimize disruption of tip support and restore support with suture and grafting techniques.

Finally, as an individual ages, several of these congenital, iatrogenic, and traumatic etiologic factors in the loss of nasal tip support are exacerbated. The fibrous support structures of the nasal tip weaken with age, and there is volume loss of the midface and maxilla (of both bony and soft tissues), leading to loss of tip projection, an acute nasolabial angle, and elongation of the nose.[10,11]

Lower Lateral Cartilage Overgrowth

An underprojected and underrotated nasal tip generally causes the perception of a long nose, rather than an actual overgrowth in nasal tissues. By contrast, a long nose can also result from overgrowth in the lower lateral cartilages, leading to nasal tip overprojection. In such cases, Tardy et al[12] found that there may be overdevelopment of the entire lower lateral cartilage or overdevelopment of the lateral crura alone. Overgrowth of the lower lateral cartilages is generally a congenital finding and is not associated with trauma, prior rhinoplasty, or aging.

Upper Lateral Cartilage Overgrowth

The lower lateral cartilages are attached to the upper lateral cartilages at the scroll area, where they have 12 to 19 mm of overlap with each other. Overgrowth of these upper lateral cartilages can displace the lower lateral cartilages caudad, decreasing tip rotation.[13-15]

High Radix

The position of the radix has an obvious effect on the perception of nasal length. The radix breakpoint is perceived as the start of the nose, and therefore a high radix causes the perception of a long nose. As Daniel[16] noted, the radix can vary in position by 12 mm or more, from the supratarsal fold to the lower eyelash, and has a profound effect on apparent nasal length.

Malposition of Subnasale or Periapical Hypoplasia

Neither subnasale malposition nor periapical hypoplasia directly affects nasal length, but they do create the illusion of excessive nasal length. A retracted subnasale will decrease tip rotation, leading to an acute nasolabial angle, creating the perception of a long nose and drooping tip. Similarly, periapical hypoplasia and superiorly displaced alar bases can have the same effect.[12]

Short Midface or Inadequate Chin Projection

An abnormally short midface or inadequate chin projection (as compared with the upper face or each other) can therefore create the illusion of a long nose. It is important to first determine whether the nose needs correction, or whether addressing the midface or lower face would be preferable.

ALGORITHM FOR MANAGING THE LONG NOSE

It is critical to begin with systematic nasal analysis to determine the goals of the surgery, the cause of the deformity along with the abnormal anatomic structures, and the degree of correction required. In general, surgical correction of the long nose involves reduction of one or more oversized nasal structures as well as the reestablishment or addition of structural support.

Systematic nasal analysis is important to determine the true cause of the long nose and to guide surgical management.

In general, surgical correction of the long nose involves reduction of one or more oversized nasal structures as well as the reestablishment or addition of structural support.

Cartilaginous Septal Overgrowth

Resecting a portion of the cartilaginous septum is generally necessary to correct this defect. This approach was described by Joseph.[2] Sajjadian and Guyuron[13] recommended overresecting by 50% to achieve the desired effect (for example, to reduce nasal length by 1 mm, the length of anterior septum removed should be 1.5 mm). They also recommended removing a proportional amount of membranous septum to prevent a hanging columella.

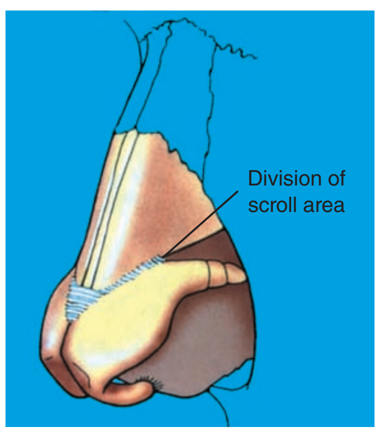
Septal overgrowth results in an overprojected tip and has a variable effect on tip rotation, depending on whether the overgrowth is of the dorsal or caudal septum.

Dorsal Septal Overgrowth

Several surgical steps must be taken to address dorsal septal overgrowth:

1. Perform component dorsal reduction with resection of the dorsal septum.
2. Perform tip deprojection.
3. Increase tip rotation.
4. Increase tip support.

An open approach is preferred to carry out the extensive tip and septal work required. The shape of the resected dorsal septal cartilage is important for determining the impact on the dorsum-tip relationship and the supratip break.

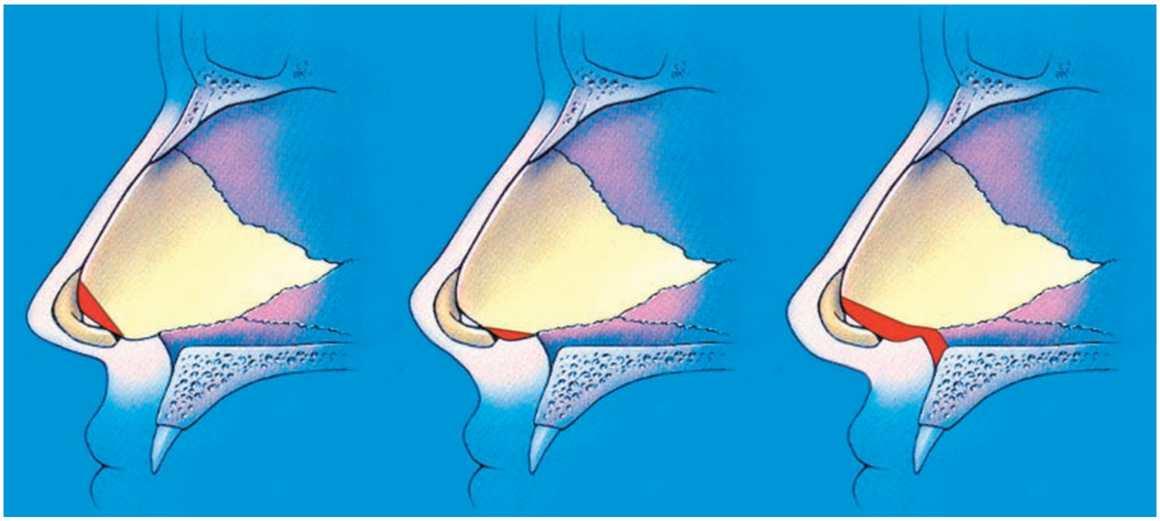


Tip deprojection requires release of the scroll attachments and release of the suspensory ligament attaching the domes to each other and the anterior septal angle. This will allow the lower lateral cartilages to move posteriorly and to deproject. Once this has been done, the projection and rotation of the tip can be controlled with suture techniques (transdomal, interdomal, lateral crural steal, or medial crural repositioning) and/or cartilage grafting (columellar strut grafts or septal extension grafts).

Caudal Septal Overgrowth

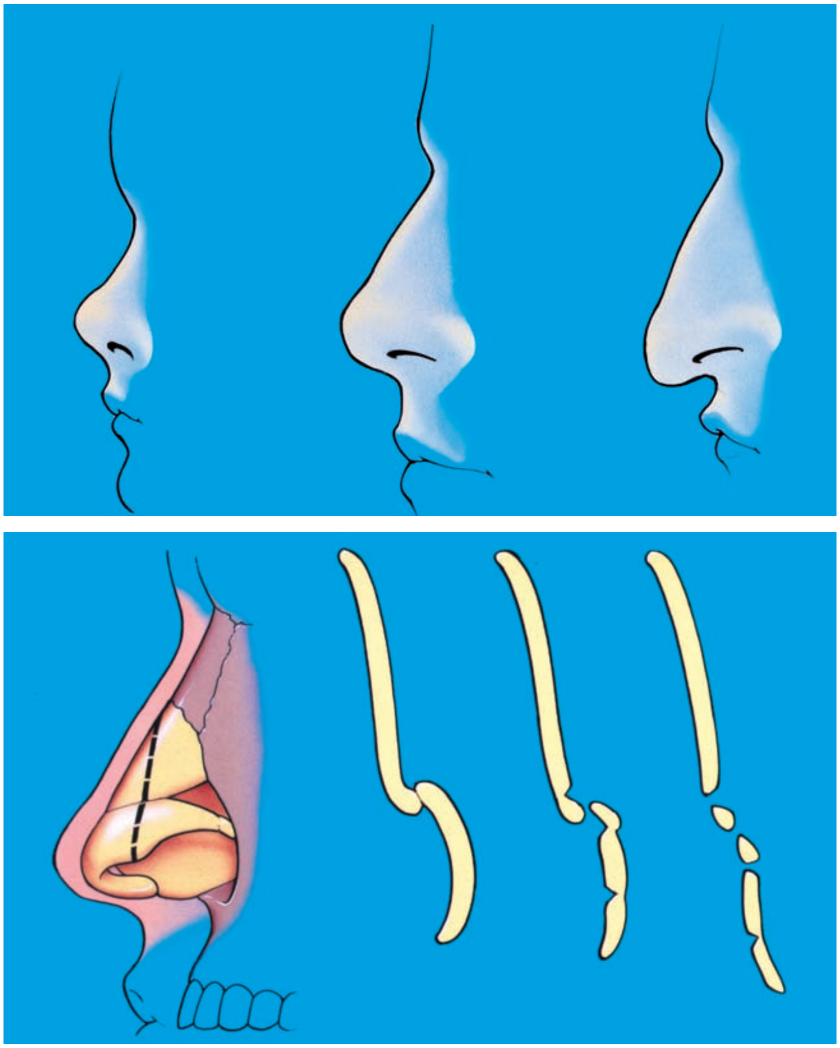
Several surgical steps must be taken to address caudal septal overgrowth:

1. Perform caudal septal resection.
2. Perform tip deprojection.
3. Increase tip support.



Similar to the dorsal septal overgrowth deformity, an open approach is preferred, followed by resection of the caudal septum. A component dorsal reduction may not be required if there is no dorsal hump. Deprojection is still necessary, because the tip will generally be overprojected as a result of septal overgrowth. Following this, the tip position must again be controlled with suture techniques and/or cartilage grafts. Typically, the tip is overrotated and may not appear elongated. Caudal septal resection will also influence the nasolabial angle and the amount and area of caudal septal resection should be carefully planned. A triangular wedge resection will not change the base of the columella and therefore will increase tip rotation alone. On the other hand, a rectangular resection will displace both the tip and the columella cephalically and will have less effect on rotation.

Inadequate Tip Support



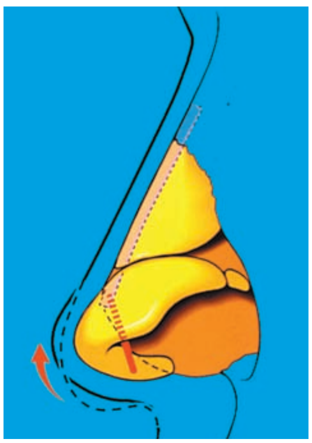
To restore tip support, the surgeon must address the underlying cause of the deficiency. As mentioned previously, the underlying cause can be congenital, traumatic, or iatrogenic or can be associated with aging. In general, lost fibrous connections between the upper lateral cartilages and lower lateral cartilages, and between the domes of the lower lateral cartilages may require restoration; the lower lateral cartilages may need to be repositioned or reshaped; and volume or support may need to be restored at the subnasale and periapical regions.

The concept of the nasal tip tripod was introduced by Anderson[17] with the tip supported by three legs—the two lateral crura and the conjoined medial crura (see Chapter 40). All the approaches involve lengthening and strengthening the conjoined medial crura leg or shortening the two lateral crural legs. This will increase both tip rotation and support. Tip projection will also be influenced by these maneuvers.

Cartilage Suturing

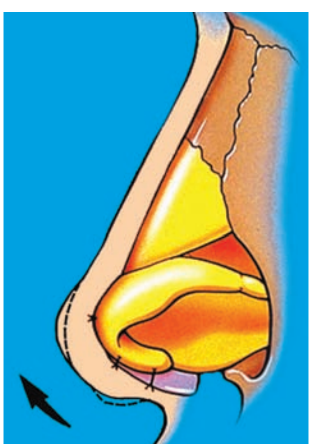
Lateral crural steal, described by Kridel et al,[18] involves recruiting length from the lateral crura and to the medial crura. The lower lateral cartilages are dissected free of overlying skin and underlying mucosa to mobilize them completely. The lateral crura are advanced medially onto the medial crura, and transdomal sutures are used to establish new domes. Further refinement can be achieved by joining the two new domes to each other with interdomal sutures. This lengthening of the medial crural leg and simultaneous shortening of the lateral crura results in increased tip rotation and tip projection.[19]

If the medial crura have insufficient stability, intercrural sutures uniting the medial crura can have a significant impact on tip support.

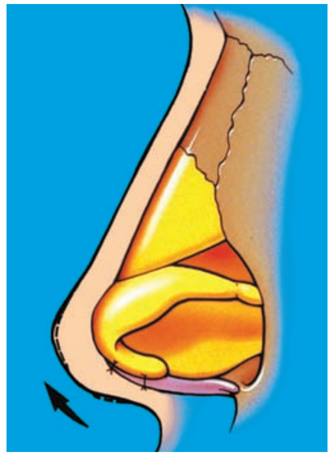


Fred[20] described separation of the medial crura, followed by repositioning on the anterior septum to more directly control tip rotation and projection. The medial crura are completely dissected free of skin and mucosa, and mucoperichondrial flaps are raised from the septal cartilage. The medial crura are then positioned over the septal cartilage and fixed in this location with 5-0 PDS medial crural-septal sutures.

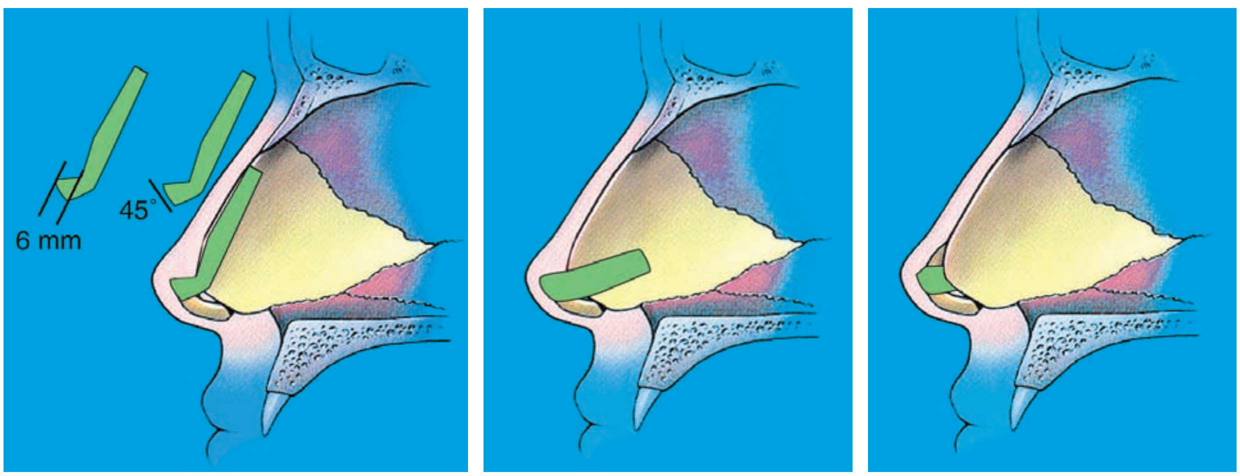
Cartilage Grafting



If the medial crura do not have adequate stiffness to maintain projection with suture techniques alone, further strength can be provided with a cartilage graft. A columellar strut graft may also be incorporated and medial crural–columellar strut sutures are used to strengthen the medial leg of the tripod. Columellar strut grafts can widen the columella, and careful graft design and suturing technique will avoid this problem.



If additional support is required, a fixed columellar strut graft can be placed on the premaxilla for stability.[21]



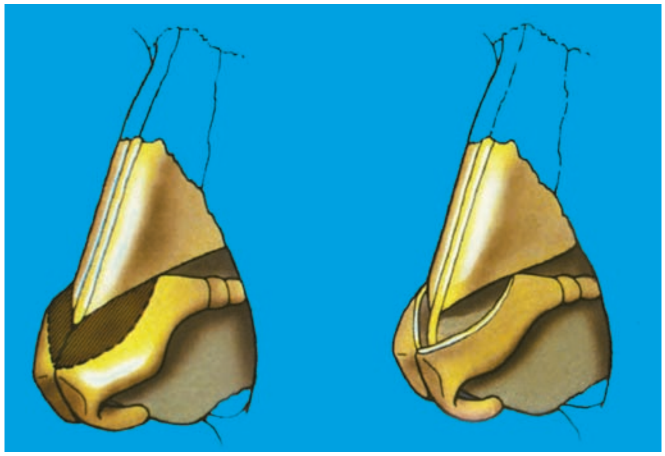
Paired extended spreader grafts
Paired batten grafts
Direct extension graft

Byrd et al[22] reported that a floating columellar strut may not be adequate to maintain nasal tip projection in patients with weak lower cartilages, retracted alae and plunging tips. In these cases, septal extension grafts that allow securing the tip complex directly to the anterior septum can be used to set and control tip position.

Lower Lateral Cartilage Overgrowth

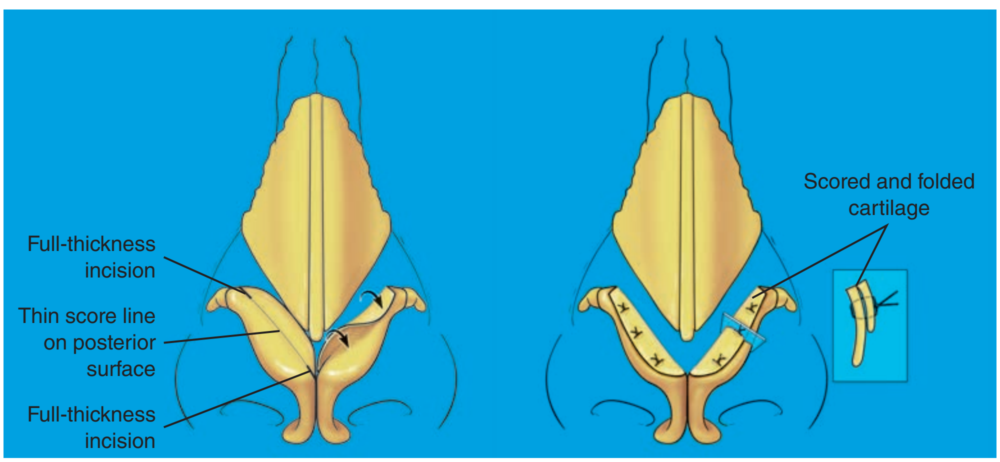
Large lower lateral cartilages will generally overproject the nose and can decrease the nasolabial angle. This must be addressed by adequately reducing the excessive crura, and by fixing the tip in a new and more appropriate position.

Cephalic Trim



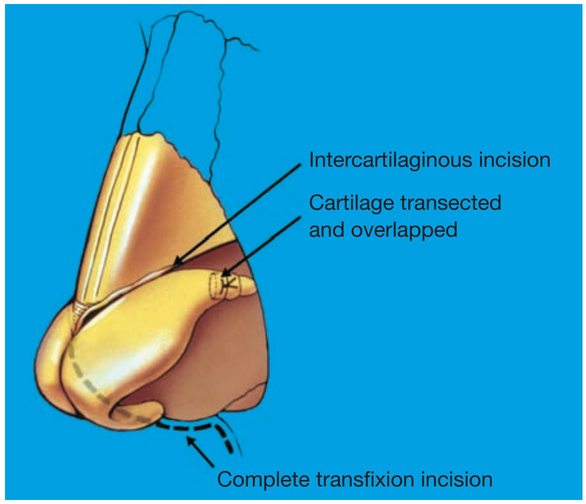
In patients with increased height of the lateral crura, cephalic resection of the lateral crus (cephalic trim) can be performed to increase tip rotation and shorten the nose. To avoid excessive weakening of the lateral crura and external valve collapse, a 6 mm alar rim strip should be preserved.

Lower Lateral Crural Turnover Flap



Alternatively, the lower lateral crural turnover flap can be employed to preserve this cartilage, which can be used to correct concavities or convexities of the lower lateral crus, strengthen the external valve, and oppose pinching of the tip from tip suturing.[23] This exploits intrinsic concavities or convexities of the lateral crus and repositions these forces into opposition, resulting in correction of the deformity. This flap is particularly useful when the lower lateral cartilages appear weak and will help to reduce tip fullness while making use of the intrinsic strength of the lower lateral cartilages.

Transection and Overlap of the Lower Lateral Crura



Transection and overlap of the lateral crura will decrease the length of the lateral crural leg of the tripod.[24] This results in deprojection of the nose as well as increased tip rotation. Foda and Kridel[19] found that the lateral crural overlay technique tended to produce a greater effect on tip rotation than the lateral crural steal technique did.

Upper Lateral Cartilage Overgrowth

Overgrowth of the upper lateral cartilages is likely to be present in combination with one or more of the other anatomic abnormalities seen in long noses.

Cingi et al[25] described correction of a long nose deformity with removal of a 3 to 6 mm triangle of cartilage from the caudal aspect of the upper lateral cartilages through a closed approach, and reported good outcomes. Resection of the caudal aspect will release the attachments to the lower lateral cartilage at the scroll area; this may affect tip projection as well.

High Radix

A high radix is often associated with a dorsal hump. Generally, the dorsal hump is reduced first allowing access to the radix. The amount of bony resection is dependent on the preoperative analysis. Guyuron[26] noted that the response of the surface anatomy to bony reduction is only 18% to 29% (that is, for every 1 mm of increased depth of the radix, 4 mm of bone must be resected).

Bony resection can be achieved in several ways. Manual rasping can be difficult because of the large amounts of bone that must be removed to create a visible external contour change. Daniel[16] used a curved gouge to remove a bony block measuring 4 to 8 mm in thickness. Guyuron[27] recommended the use of a guarded high-speed burr to remove greater quantities of bone in more severe cases. Decreasing radix height can lead to a perceived increase in the intercanthal distance, so care must be taken during this procedure to not disturb the rest of the nasofacial aesthetics.

Subnasale or Periapical Augmentation

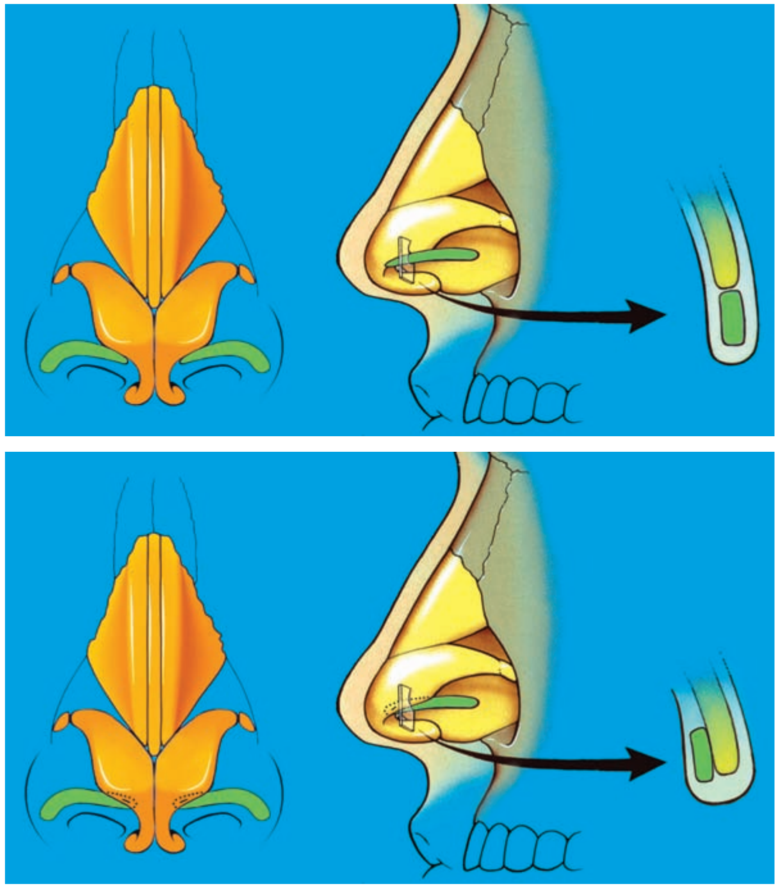
Either a retracted subnasale or periapical hypoplasia can create the appearance of a long nose. A retracted subnasale can be corrected by augmenting the subnasale with cartilage grafts or soft tissue fillers. This will decrease the perceived projection of the tip and the nasal length and can increase tip rotation and the nasolabial angle resulting in a perceived shortening of the nose.

Periapical hypoplasia is often seen in patients who have congenital or iatrogenic midface hypoplasia (as in patients with a cleft palate). This can be corrected by restoring volume with soft tissue fillers or fat grafting.

Midface/Chin Correction

Ideal nasal length is a relative measurement and depends on the dimensions of the midface and lower face. Therefore, in cases where the true deformity lies either in the length of the midface or lower face, craniofacial or orthognathic surgery may be necessary to lengthen the middle or lower thirds. In some cases, chin augmentation may be adequate to improve nasofacial balance.

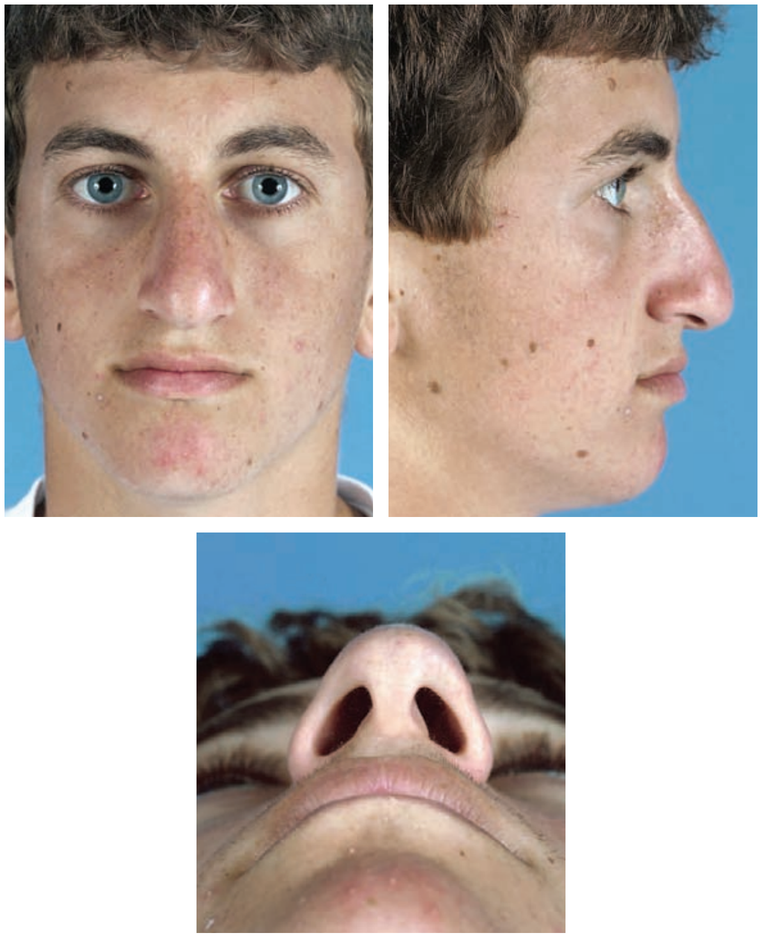
Adjunctive Procedures



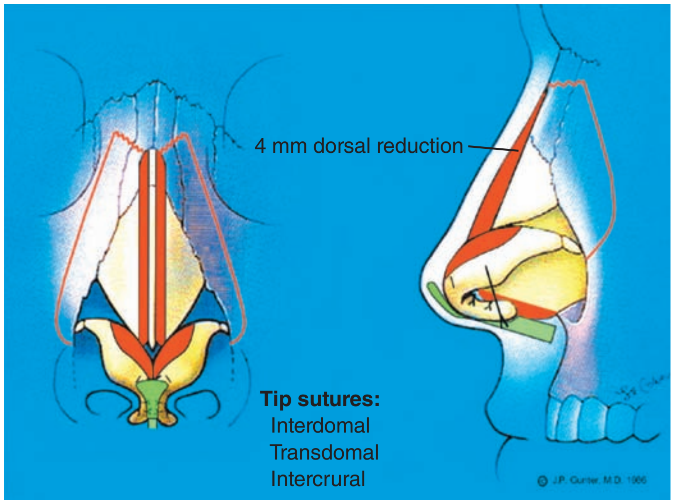
Manipulation of the lower lateral cartilages may decrease support to the alar rim, predisposing to alar notching and/or retraction. Nonanatomic placement of alar contour grafts or extended alar contour grafts can reduce the risk for these deformities.[28]

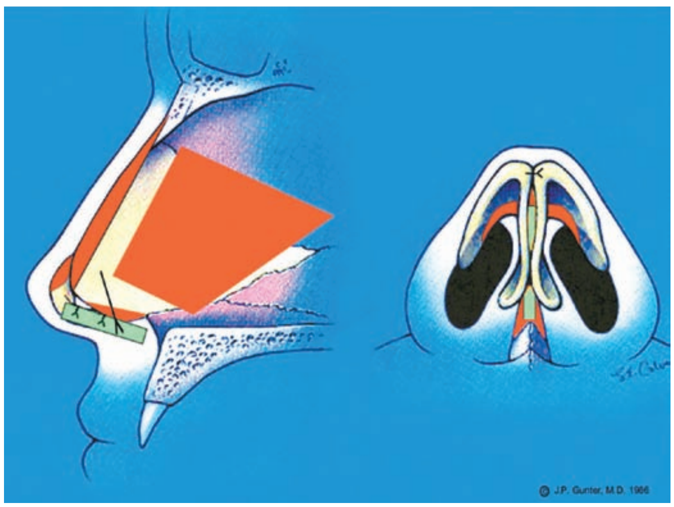
After reduction of dorsal septal overgrowth, the nasal dorsum must be reconstituted to create smooth dorsal aesthetic lines and optimize internal valve function. Upper lateral tension-spanning sutures, autospreader flaps, or spreader grafts may be required.[29-32]

CASE ANALYSES



This young man had a reverse-C–shaped deformity of his nasal dorsum with deviation of his tip to the right.[33] The bony vault was wide. His nasal tip was large and ill defined, with an excess infratip lobule. This exaggerated the plunging nature of the tip and gave his nose an elongated appearance. The lateral view revealed a moderate dorsal hump with supratip fullness. He had an underrotated tip with an acute columellar-labial angle that also contributed to the elongated appearance on profile. The patient also complained of nasal airway obstruction on the right side.

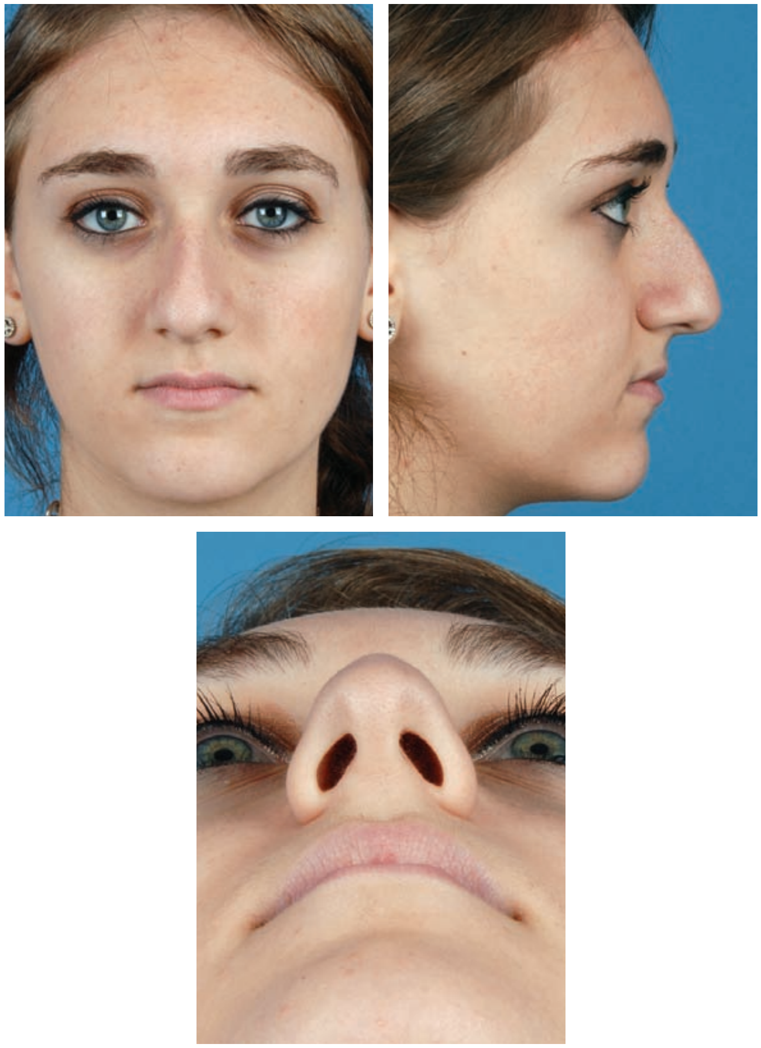




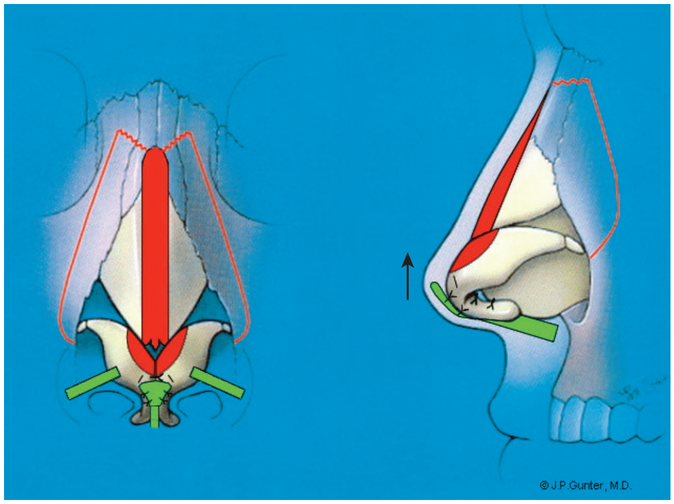
The operative goals included the following:

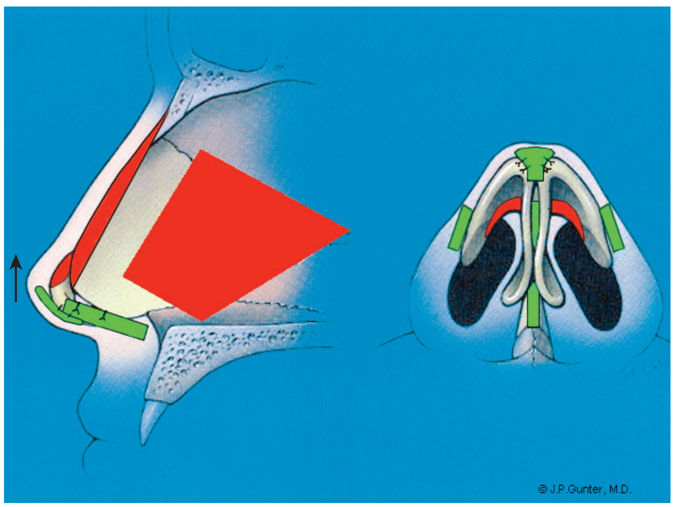
- Use an open approach.
- Perform a component dorsum reduction of 4 mm.
- Resect the caudal septum.
- Perform septal reconstruction and harvest septal cartilage.
- Perform cephalic trim of the lateral and middle crura, leaving 6 mm of alar rim strip.
- Secure a columellar strut graft with intercrural sutures.
- Use medial crural–columellar strut–septal sutures to affix the medial crural–columellar strut graft to the septum.
- Place interdomal and transdomal sutures to refine the tip.
- Craft and place an infralobular onlay graft.
- Perform percutaneous perforated nasal osteotomies.

The patient is shown 1 year postoperatively.[33] Note the smooth, straight dorsum and correction of the dorsal aesthetic lines. He has appropriate tip projection, and rotation and his nose no longer appears so elongated.



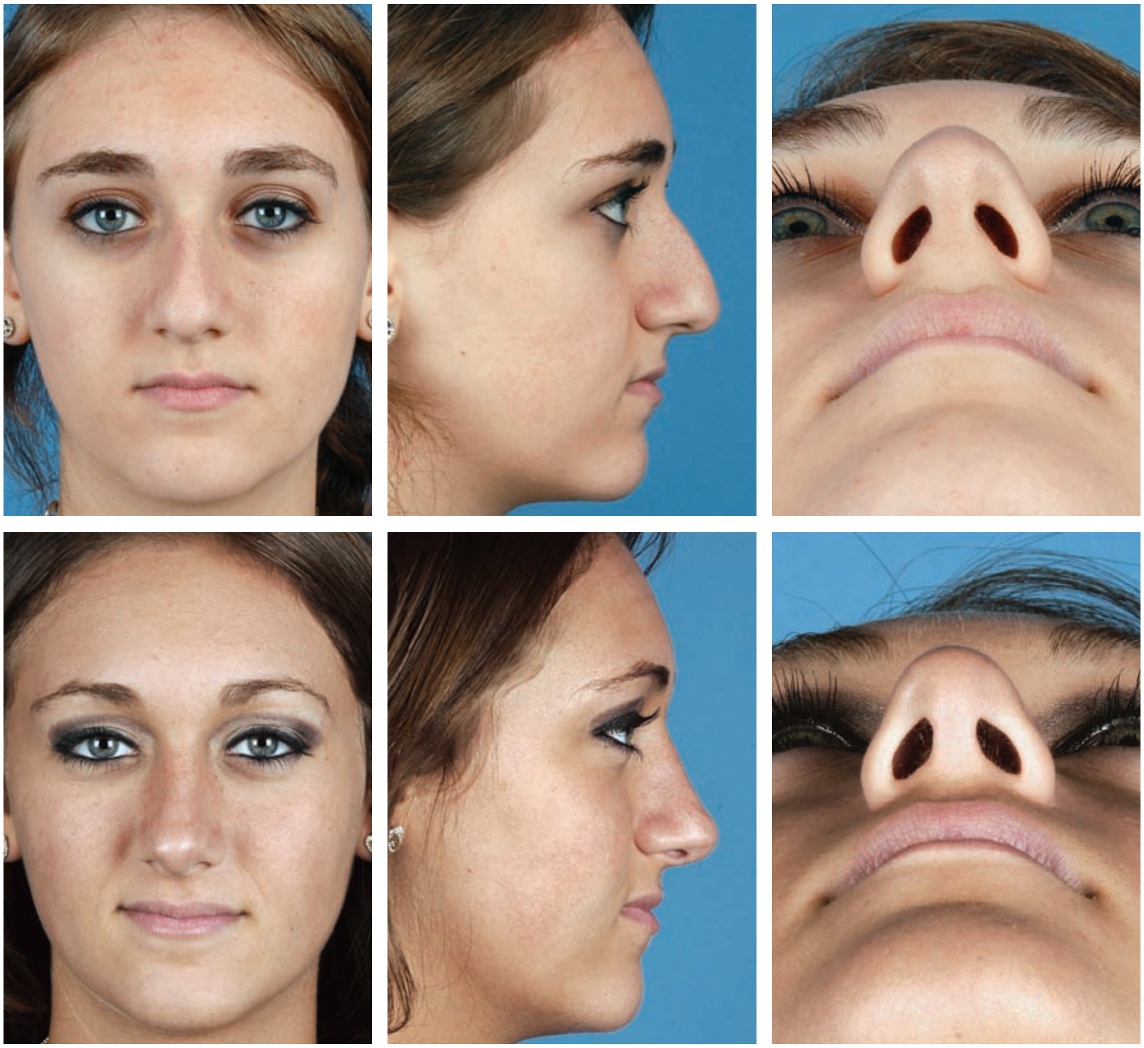
This patient complained of a large dorsal hump and an ill-defined tip. In addition, she had significant nasal airway obstruction. The nasal tip was large and ill defined, with an excess infratip lobule. This exaggerated the plunging nature of the tip and gave her nose an elongated appearance. On the lateral view, the large dorsal hump with supratip fullness was evident. She had an underrotated tip with short infratip lobule that contributed to the elongated appearance.





The operative goals included the following:

- Use an open approach.
- Perform a component dorsum reduction of 4 mm.
- Perform septal reconstruction and harvest septal cartilage.
- Perform submucous resection of the inferior turbinates.
- Perform cephalic trim of the lateral and middle crura, leaving 6 mm of alar rim strip.
- Secure a columellar strut graft with intercrural sutures.
- Place interdomal and transdomal sutures to refine the tip.
- Craft and place an infralobular onlay graft.
- Place bilateral alar contour grafts.
- Perform percutaneous perforated nasal osteotomies.



The patient is shown 22 months postoperatively. She has better balance between the dorsum and tip, including improvement in the infratip lobule. On lateral view, she has a smooth, straight dorsum and supratip break. She now has more balanced tip projection and rotation and no longer has the appearance of an elongated nose.

KEY POINTS

- Systematic nasal analysis is important to determine the true cause of the long nose and to guide surgical management.
- Nasal length is defined as the distance from the root of the nose to the tip.
- Overgrowth of the cartilaginous septum is a common feature of the long nose and generally causes overprojection of the nasal tip; it has a variable effect on tip rotation.
- Inadequate tip support is likely the most common cause of the long nose. A lack of tip support will result in the unopposed effects of gravity on the tip, leading to descent of the tip and a decrease in tip rotation and tip projection.
- In general, surgical correction of the long nose involves reduction of one or more oversized nasal structures as well as the reestablishment or addition of structural support.

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Elongation of the Short Nose

Bahman Guyuron

One of the features that adds to the complexity of rhinoplasty is a length deficiency, especially if the deficit is substantial. In this chapter, we will discuss the cause, management, and surgical techniques for elongation of the short nose and related nuances.

CAUSES OF A SHORT NOSE

Excessive cephalic rotation of the nose is a hallmark of the rhinoplasties performed from the 1960s to the mid-1980s. Specifically during this era, iatrogenic short noses were routine, a result of both the surgeons' and patients' aesthetic standards. Today, trauma is a common cause of a short nose. Other reasons include ablative surgery, loss of the septum to cocaine abuse, Wegener's granulomatosis, or congenital short nose. It is crucial to clearly determine whether the deficiency is in the anterior length of the nose, the posterior length of the nose, or both. The nose can be short because it is overrotated, or the entire nose may be short. These two deficiencies have different causes and will require somewhat different management.

It is crucial to clearly determine whether the deficiency is in the anterior length of the nose, the posterior length of the nose, or both.

The nose can be short because it is overrotated, or the entire nose can be short.

An overrotated nose is usually the consequence of surgical removal of a segment of the anterocaudal septum, collapse of the septum as a result of a caudal blow to the nose, or destruction of the caudal septum by cocaine abuse. In this group of patients, the nasal spine and the base of the columella are in an optimal position, and structural elongation will only be anterior. Most congenitally short noses have deficiency evenly distributed through the caudal septum, and the nasal spine is deficient or completely missing, as in patients with Binder's syndrome. A patient may ostensibly have a short nose because of a low radix.

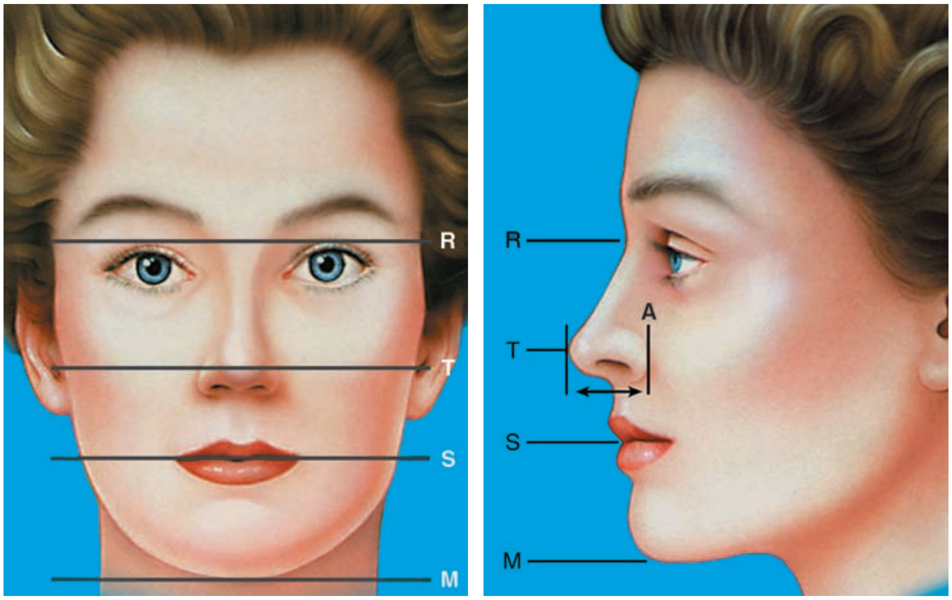
A patient may ostensibly have a short nose because the radix is low.

PATIENT ASSESSMENT

A complete understanding of the nature of the deficiency requires assessment of the magnitude of the deficit and the involved structures and is a key factor in successful correction of a short nose deformity. Ideally, the deficiency is corrected in all of the structures. It is therefore crucial to identify the extent of the deficiency in the caudal septum, medial crura, lateral crura, and soft tissues. A patient with a short nose and retracted alae poses a far greater challenge than a patient who has hanging alae and a retracted columella. Additionally, the suppleness of the soft tissues of the caudal nose is very important. A rigidly scarred nose that cannot be elongated by pulling of the columella caudally is more difficult to correct and may require a soft tissue graft. This category of deformity is exceedingly rare.

A patient with a short nose and retracted alae poses a far greater challenge than a patient who has hanging alae and a retracted columella.

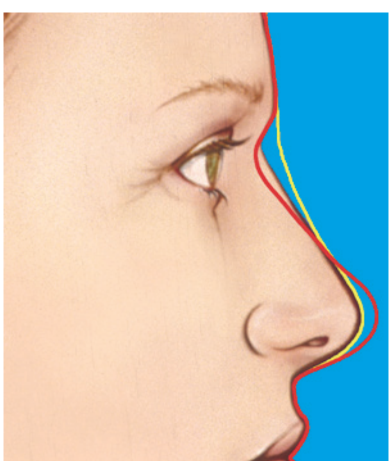
A rigidly scarred nose that cannot be elongated by pulling of the columella caudally is more difficult to correct and may require a soft tissue graft.



Ideally, the length of the nose from the deepest portion of the radix *(R)* to the tip *(T)* is twice the length of the upper lip and approximately equal to the distance from the stomion *(S)* to the menton *(M)*.[1] However, the upper lip can only be used for reference if it is deemed ideal. The nose deficiency can be mild (less than 3 mm), moderate (3 to 5 mm), or severe (more than 5 mm).

Ideally, the length of the nose from the deepest portion of the radix to the tip is twice the length of the upper lip and approximately equal to the distance of the lower face from the stomion to the menton.

OPERATIVE TECHNIQUE

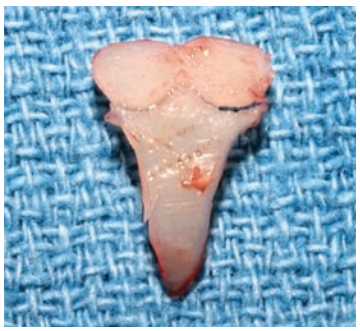


If the nose appears short because of a low radix, deepening of the radix cephalically or augmentation of the dorsum will provide an elongated appearance.[1]

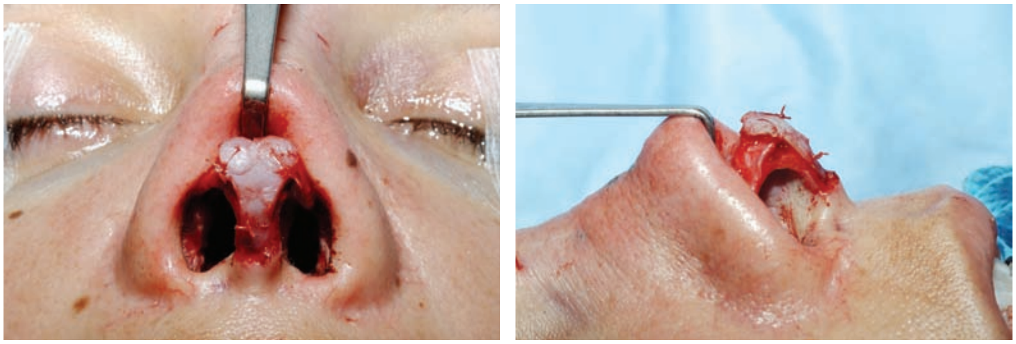
The caudal portion of a columellar strut graft will extend beyond the dorsum by 6 to 8 mm depending on the thickness of the skin and will be slightly angulated cephalically.

A nose that is short and overprojected can appear to be longer after derotation. Surgical management of the true short nose is dependent on the extent of the deficiency and the position of the alar rim and columella.

A short and overprojected nose can appear to be longer after derotation.



When the deficiency is solely in the infratip lobule and columella and the alae are only minimally retracted, a shield-type tip graft is applied through an open or closed technique, depending on the other indicated maneuvers and the use of alar rim grafts. This deformity can be corrected through an alar rim incision using a shield graft.[2] The alar rim graft is inserted through the same incision. Commonly, however, the nose length deficiency is corrected concomitantly with other abnormalities that require exposure of the medial and lateral crura, thus necessitating an open approach. In this case, the medial crura can be approximated first. A shield graft is then carved using a tip punch.[1,3] Additionally, septal cartilage or a conchal graft can be used. The margins of the shield graft are beveled, emulating the natural domes and an infratip portion. The graft is designed in one of two ways. It can slightly drape over the existing domes and prevent a clearly visible outline if a tip projection deficiency exists. Alternatively, it can be added caudal to the current domes to elongate the lobule only, without gaining tip projection.



The graft is sewn to the underlying structures precisely using three 6-0 Vicryl sutures while it is asessed three dimensionally.[1] The three stitches include one on each dome and one on the columella. A second layer can be applied if necessary.

This patient is shown before and after this type of tip elongation.[1] The technique can be combined with an alar rim graft or V-Y advancement to advance the alae caudally to maintain or restore harmony between the alae, the columella, and the lobule.

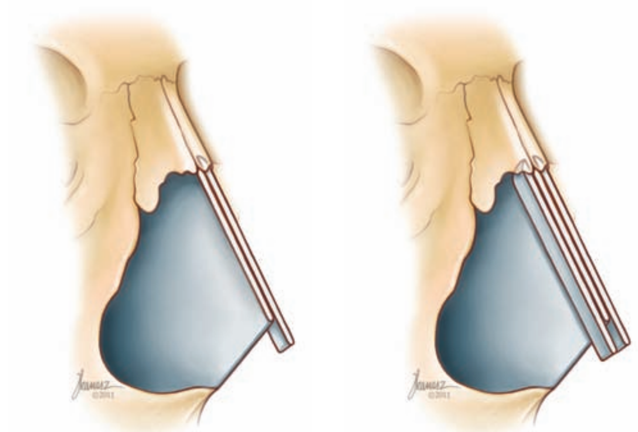
For a moderate to severe length deficiency, the treatment choices include a septal extension graft, a composite graft, or a tongue-and-groove–type elongation with extended spreader grafts. A septal extension graft can be placed in continuity with the septum and sutured to the medial crura. It is essential to maintain alignment. Because no reliable means are available to contain the septal extension

graft in continuity with the septum, the graft will probably shift to one side of the septum unless some type of bar is extended from each side of the septum to encase the columellar strut. Some surgeons successfully use such additional grafts on one side, or they place one graft on either side of the septum. The added graft bulk can alter the anatomy of the vestibule. This can unnecessarily create extra bulk on one side, resulting in an asymmetrical caudal septum and columella or protrusion on both sides of the septum. The tongue-and-groove technique that we have described has been extremely predictable in achieving the goal of nasal elongation without asymmetery.[4]

Tongue-and-Groove Technique

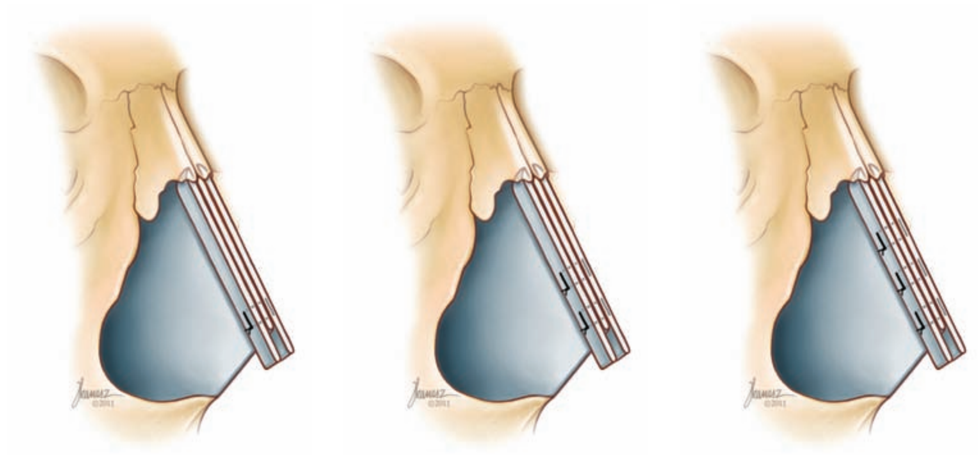
The tongue-and-groove technique is an optimal approach for elongation of a moderately or severely short nose, especially one that is overrotated. Through an open approach, after dorsal irregularities are corrected and osteotomies are completed, two pieces of long spreader grafts are harvested ideally from the septum. Rib cartilage can be used if the septum is not available. Conchal cartilage is less suitable for this purpose.

Conchal cartilage is less suitable than septal or rib cartilage for a tongue-and-groove procedure.

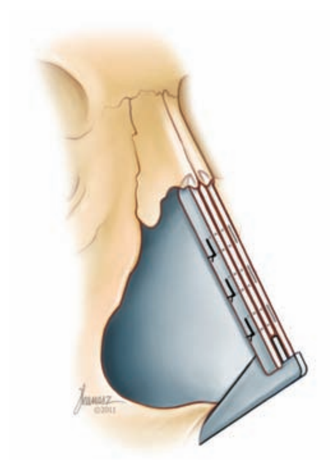


The cartilage grafts are designed to be long enough to extend from underneath the nasal bones to beyond the anterocaudal septum, in proportion to the required elongation.[1] For example, if the deficiency is 5 mm, the spreader grafts will extend beyond the anterocaudal septum by 5 mm.

To elongate the nose, two spreader grafts are designed to be long enough to extend from underneath the nasal bones to beyond the anterocaudal septum in proportion to the elongation necessary.



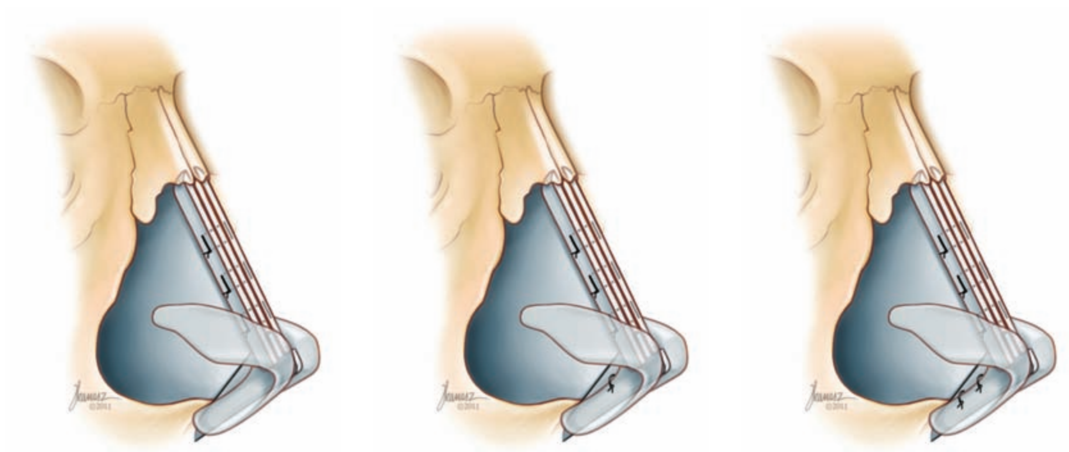
The spreader grafts are sutured to the septum using two or three sutures of 5-0 double-armed Vicryl or PDS.[1] The upper lateral cartilages are then sutured to the spreader grafts using 5-0 PDS.



A columellar strut is prepared in a triangle shape if the anterior nasal spine and caudal septum are in a proper position posteriorly.[1] If the posterior portion of the nose is short, the base of the columella is advanced by a graft that is carved to have enough width posteriorly. The anterior portion of the columellar strut at the level of the dorsum should equal the elongation necessary. (In this example,

the length is 5 mm plus the width of the medial crura.) The width of the portion of the columellar strut extending beyond the dorsum equals that of the medial crura, and this extension is about 6 to 8 mm, depending on the thickness of the skin. However, the anterior extension of the columella beyond the level of the dorsum is only as wide as the medial crura to prevent supratip fullness, and it is slightly angulated cephalically to provide a desirable columellar-lobular angle. As the medial crura are sewn to the columellar strut, the anterior nose will be elongated as planned. If the footplates are divergent, invariable caudal advancement of the columellar base will occur as a result of approximation of the footplates.[5]

A columellar strut graft is prepared in a triangle shape whose width is equal to the elongation necessary plus the width of the medial crura.



The medial crura are then approximated to the columellar strut and sutured in at least two sites using 5-0 PDS.[1] Often the columellar strut is not sutured to the extended spreader grafts unless increased tip projection is needed in addition to nose elongation. If a gain in projection is part of the aesthetic goal, a 5-0 clear nylon suture (rather than PDS) is used to suture the medial crura to the columellar strut in a more projected position.[6]

It is absolutely essential to ensure that the lateral crura follow the central structures. This is facilitated by careful cephalic dissection of the lateral crura of the lower lateral cartilages. If necessary, they are completely mobilized, repositioned caudally, and placed in a new soft tissue pocket. This may require placement of a lateral crural strut graft to achieve an aesthetically more pleasing outcome and strengthen the external and internal valves.

It is critical that the lateral crura follow the central structures to prevent a discrepancy in the alar-columellar relationship.

In patients who have a great deal of scarring, it may be necessary to release the scar tissues to be able to advance the frame caudally. It is often necessary to dissect the dorsal soft tissues further cephalically, extending along the nasal bones to allow unrestrained advancement of the soft tissues.

In patients with considerable scarring, release of this tissue may be required to advance the frame caudally.

Irreparably scarred soft tissues are released. This includes an incision in the nasal lining. Next, an elliptical piece of composite ear skin and conchal cartilage is harvested and applied to either side cephalad to the existing lower lateral cartilages and the columella. They are fixed in position using 5-0 chromic interrupted sutures to ensure isolation of the nasal cavity from the dorsum. However, this is seldom necessary, even on noses that are seemingly scarred severely. Usually, careful dissection of the soft tissues and a properly planned and normal-length frame yields a surprisingly significant elongation and stretches the soft tissues proportionally.

CASE ANALYSIS

This patient underwent elongation of her short nose using the tongue-and-groove technique. The operation, though labor intensive, was very rewarding.[1]

Surgical Plan

1. Perform an open technique.
2. Complete a low-to-low osteotomy bilaterally.
3. Elongate the nose using a tongue-and-groove technique.
4. Apply a columellar strut graft.
5. Approximate the medial crura.
6. Place an onlay tip graft.
7. Apply a dorsal graft.
8. Apply alar contour grafts bilaterally.
9. Apply an upper lateral extension graft.

For patients who do not have a proper anterior nasal bar for the dorsal support and thus elongation of the nose, a dorsal graft that will be engaged with a strong columellar strut will provide the needed length reliably.

POTENTIAL SHORTCOMINGS AND PITFALLS

If nose elongation is completed in conjunction with an augmentation of the tip projection, which requires fixation of the columellar strut to the extended spreader grafts, it will result in some rigidity of the nose tip. As long as the patient is informed of this change and accepts the potential stiffness, it does not pose a significant problem.

Another potential problem results from failure to advance the alae commensurate with advancement of the columella. This will create an unfavorable protrusion of the columella, and the alae will appear to be retracted.

Failure to advance the alae commensurate with advancement of the columella will create an unfavorable protrusion of the columella, and the alae will appear to be retracted.

Sufficient dissection of the soft tissues and repositioning of the lateral crura will reduce this potential problem. If necessary, alar contour grafts or a lateral crural strut graft, V-Y advancement, or bilateral composite grafts should be used to ensure that the alae follow the tip and columella. Otherwise, a shorter nose with a balanced alar-columellar relationship is less displeasing than a longer nose with only the central portion advanced. The soft tissue should be repaired with minimal tension to prevent columellar skin necrosis, which is one of the most difficult areas to reconstruct.

Soft tissue should be repaired with minimal tension to prevent columellar skin necrosis, which is one of the most difficult areas to reconstruct.

KEY POINTS

- It is crucial to clearly determine whether the deficiency is in the anterior length of the nose, the posterior length of the nose, or both.
- The nose can be short because it is overrotated, or the entire nose can be short.
- A patient may ostensibly have a short nose because the radix is low.
- A patient with a short nose and retracted alae poses a far greater challenge than a patient who has hanging alae and a retracted columella.
- A rigidly scarred nose that cannot be elongated by pulling of the columella caudally is more difficult to correct and may require soft tissue graft.
- Ideally, the length of the nose from the deepest portion of the radix to the tip is twice the length of the upper lip and approximately equal to the distance of the lower face from the stomion to the menton.
- The caudal portion of a columellar strut graft will extend beyond the dorsum by 6 to 8 mm depending on the thickness of the skin and will be slightly angulated cephalically.
- A short and overprojected nose can appear to be longer after derotation.
- Conchal cartilage is less suitable than septal or rib cartilage for a tongue-and-groove procedure.
- To elongate the nose, two spreader grafts are designed to be long enough to extend from the underneath the nasal bones to beyond the anterocaudal septum in proportion to the elongation necessary.
- A columellar strut graft is prepared in a triangle shape whose width is equal to the elongation necessary plus the width of the medial crura.
- It is critical that the lateral crura follow the central structures to prevent a discrepancy in the alar-columellar relationship.
- In patients with considerable scarring, release of this tissue may be required to advance the frame caudally.
- Failure to advance the alae commensurate with advancement of the columella will create an unfavorable protrusion of the columella, and the alae will appear to be retracted.
- Soft tissue should be repaired with minimal tension to prevent columellar skin necrosis, which is one of the most difficult areas to reconstruct.

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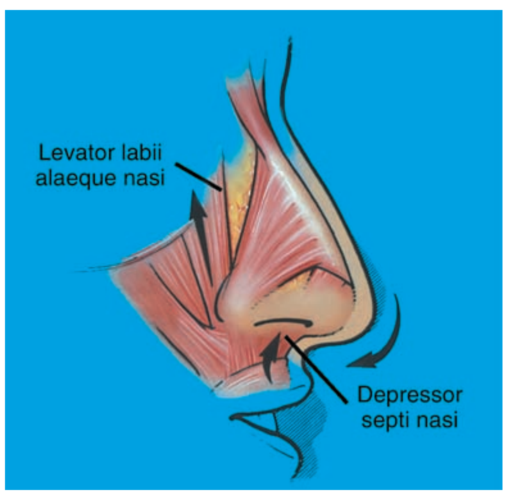
Enhancing the Nasal Tip–Upper Lip Relationship: The Importance of the Depressor Septi Nasi Muscle in Rhinoplasty

Rod J. Rohrich ▪ William P. Adams Jr. ▪ Jamil Ahmad

The plunging nasal tip is a difficult problem in rhinoplasty that is accentuated by an active depressor septi nasi muscle and diagnosed by a drooping nasal tip and shortened upper lip during animation (smiling).[1-19]



The depressor septi nasi muscle is a small, paired muscle located on either side of the nasal septum, originating from the medial crural footplates. Early techniques generally treated this problem by resection of the muscle.[10-13] Previously, we described transoral dissection and transposition of the muscle.[1] More recently,

Botox has been used to correct a plunging nasal tip resulting from activity of this muscle.[19]

The depressor septi nasi muscle can accentuate a drooping nasal tip and short upper lip on animation.

The anatomy and function of the depressor septi nasi muscle have been described.[1-4,6-8] In 2000 we performed an anatomic study to better understand variations in this muscle's anatomy.[1] The specific purpose of our study was to delineate the anatomic variations of the muscle in fresh cadaver dissections and correlate our findings with our clinical experience to develop an applied clinical rhinoplasty algorithm. Since then, additional studies have confirmed the variant anatomy of this muscle and attempted to further describe the intricate dynamic relationships of the structures of the nasal base and upper lip.[20]

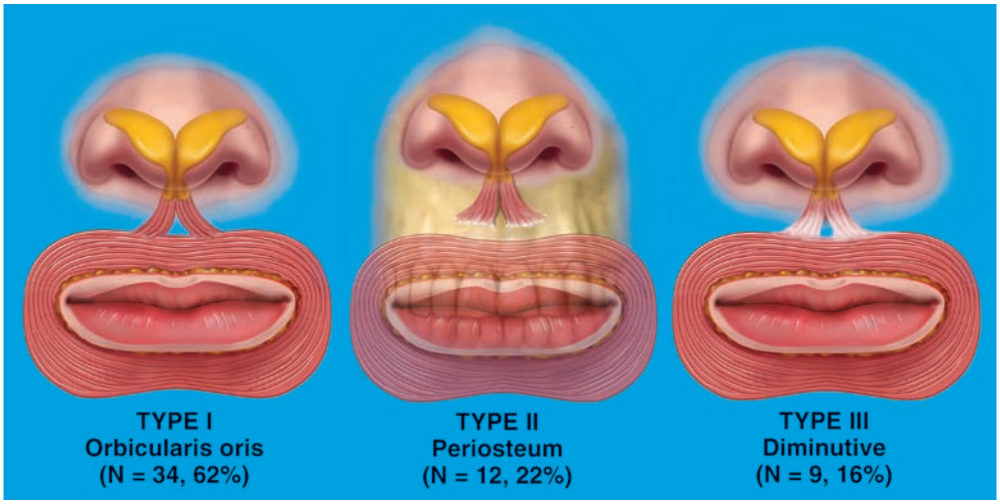
The routine preoperative rhinoplasty examination should include an assessment of the depressor septi nasi muscle. In our study, we identified 32 patients preoperatively who demonstrated dynamic shortening of the upper lip and inferior displacement of the nasal tip. Dissection and transposition of the depressor septi muscle were performed as an adjunct to rhinoplasty in this subgroup. Our anatomic and clinical studies along with clinical examples are presented in this chapter. Additionally, we describe our current algorithm to address dynamic changes of the nasal tip associated with this muscle.

The plunging nasal tip is a difficult problem in rhinoplasty. It is accentuated by an active depressor septi nasi muscle and diagnosed by a drooping nasal tip and shortened upper lip during animation (smiling). Preoperative diagnosis and operative techniques for correction of the depressor septi nasi muscle can enhance the lip–tip relationship in rhinoplasty.

ANATOMIC AND CLINICAL STUDY

In 2000 we performed both anatomic and clinical studies to better understand the structure and clinical implications of the depressor septi nasi muscle.[1] The muscle was dissected in 55 fresh cadavers. It was exposed by an external incision along the nasal base. The skin was removed, revealing the plane of the orbicularis

oris and depressor septi nasi muscles. Dissection was continued cephalad toward the nasal septum to allow visualization of the anterior nasal spine, the medial crural footplates, the medial crura of the lower lateral cartilage, and the septal cartilage. Anatomic variations of the depressor septi nasi muscles were recorded.



Three types of depressor septi nasi muscle were identified. Type I muscles (62%) are visible and identifiable and can be traced to full interdigitation with the orbicularis oris muscle from their origin at the medial crural footplate. Type II muscles (22%) are visible and identifiable, but unlike the first group, they insert into the periosteum and demonstrate little or no interdigitation with the orbicularis oris muscle. Type III muscles (16%) are not present or are rudimentary.

Three variations of the depressor septi nasi muscle were delineated: type I (62%) inserted fully into the orbicularis oris muscle; type II (22%) inserted into periosteum and incompletely into the orbicularis oris muscle; and type III (16%) were rudimentary or nonexistent.

Next, we evaluated 32 patients who preoperatively demonstrated dynamic shortening of the upper lip and inferior displacement of the nasal tip. All patients with an active depressor septi nasi muscle on preoperative examination demonstrated an identifiable depressor septi nasi muscle on exploration. In all cases, the drooping nasal tip and short upper lip were improved after dissection and transposition of the muscle. No evidence of relapse was evident at up to 2 years' follow-up

In our study 32 patients were identified preoperatively with an active depressor septi nasi muscle, diagnosed by a drooping nasal tip and shortened upper lip on animation. This subgroup underwent dissection and transposition of the depressor septi nasi muscle during rhinoplasty, with correction of the deformity in 100% of cases.

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In all patients with an active depressor septi nasi muscle preoperatively, a depressor septi nasi muscle was identified.

THE DEPRESSOR SEPTI NASI MUSCLE

The importance of the depressor septi nasi muscle in rhinoplasty has been recognized for some time. In 1976 Wright[13] reported that an overactive depressor septi nasi muscle contributes to drooping of the nasal tip and this phenomenon can be diagnosed by the smile test (that is, the nasal tip drops slightly when the patient smiles).

In 1983 Ham et al[14] reported that the muscle was responsible for tension at the tip and on the dorsum of the nose and recommended transection of the depressor septi to remedy this problem.

In 1992 Cachay-Velásquez[17] described the *rhino-gingivolabial syndrome* of the smile. He emphasized the importance of facial animation in revealing aesthetic imperfections that may otherwise go unnoticed when the face is in repose. Specifically, the rhino-gingivolabial syndrome includes drooping of the nasal tip, elevation and shortening of the upper lip, and increased maxillary gingival show. The author attributed this syndrome to hypertrophy of the depressor septi nasi muscles. His method for correction of this condition involved excision of the depressor septi nasi muscles and partial excision of the orbicularis and nasalis muscles through a transfixion incision. After many years of clinical experience with this technique, he reported no cases of nasal airway obstruction, contrary to the admonition by Converse[15] to preserve the function of this muscle.

Division of the depressor septi nasi muscle is a valuable adjunct to rhinoplasty in patients with a type I or II muscle variant and can be identified in a preoperative evaluation with a smile test.

Lawson and Reino[11] described a related method called *reduction columelloplasty.* This technique involves en bloc removal of soft tissue, including the depressor septi nasi muscle, through a full-thickness diamond-shaped excision between the feet of the medial crura. This allows direct visualization and suture plication of the splayed medial crura. As in the technique described by Cachay-Velásquez, this method results in decreased interalar distance, enhanced tip projection, and an augmented nasolabial angle.

Mahe and Camblin[6] noted that transection of the muscle may fail to produce lasting results because of reattachment of the muscle. Attempts have been made to prevent this occurrence by placing cartilage at the site of the transection.

De Souza Pinto et al[8] recently reported their *dynamic rhinoplasty* technique. These authors used a Z-plasty incision based on the frenulum. They combined release of the medial fasciculi of the depressor septi nasi muscle with either horizontal or vertical plication of the intermediate fasciculi, depending on whether the patient has a short or a long upper lip, respectively. They described a somewhat complicated classification system that delineates six different groups of patients with drooped or upright nasal tips, short or long upper lips, and two special cases of the black nose and the mouth breather. However, aside from the manipulation of the lateral fasciculi described for the black nose, the only significant difference in the treatment of the depressor septi nasi in the other groups seemed to be the direction of plication in short or long upper lips.

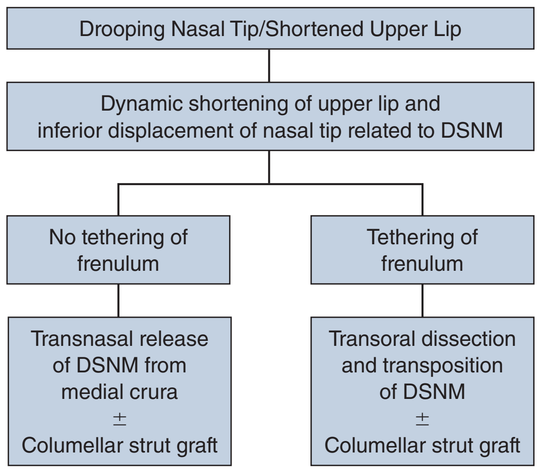
We attempted to further delineate the anatomic basis for modification of the depressor septi nasi muscle by examination of its anatomic variations.[1] Having defined three different types of depressor septi nasi muscles, we have developed an applied algorithm for treatment of the drooping tip–short upper lip complex in rhinoplasty.

PREOPERATIVE ASSESSMENT AND PLANNING

Routine preoperative examination of rhinoplasty patients should easily identify patients who have a drooping nasal tip and shortened upper lip on animation, particularly on smiling. In such patients (types I and II), release of the cephalic attachments or dissection and transposition of the caudal depressor septi nasi muscle and suturing together of the cut ends (which prevents the reattachment described by Mahe and Camblin[6,7]) reliably and effectively correct this dynamic facial deformity. Dissection and transposition rather than excision of tissue provide fullness to the central upper lip.

In appropriately selected patients, transnasal release or transoral dissection and transposition of the depressor septi nasi muscle enhances the tip–upper lip relationship, provides relative upper lip lengthening, gives relative fullness to the upper lip, and maintains tip rotation/projection on animation.

OPERATIVE TECHNIQUE



DSNM, Depressor septi nasi muscle.

Our technique to correct the depressor septi nasi muscle has evolved since 2000, and our present technique is shown in this algorithm.[21]

During the preoperative rhinoplasty examination, patients are asked to smile so that dynamic effects of the depressor septi nasi muscle on the nasal tip and upper lip can be assessed. Patients with an active depressor septi nasi muscle, as evidenced by drooping of the nasal tip and shortening of the upper lip on smiling, are candidates for transnasal release of the depressor septi nasi muscle from the medial crura. If in addition they have tethering of the frenulum, transoral depressor septi nasi muscle dissection and transposition is performed during rhinoplasty to provide additional lengthening of the upper lip.

A transnasal approach is used in most cases to release the depressor septi nasi muscles. In patients with tethering of the frenulum, a transoral approach is performed to provide additional length to the upper lip.

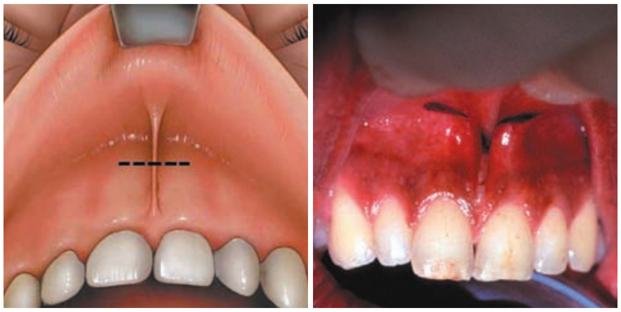
Our operative technique for transnasal release of the depressor septi nasi muscles includes the following steps.

An open approach is performed. The medial crura are dissected away from the caudal septum. Dissection along the medial crura continues posteriorly to the medial crural footplates. Before the depressor septi nasi muscles are released, traction on the lower lateral crus causes upper lip elevation.

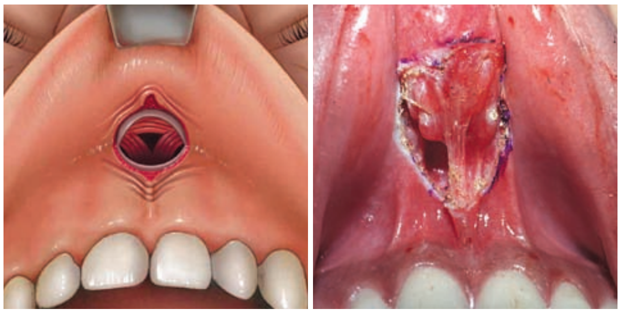
The depressor septi muscle attachments are released from the medial crural footplates.

After release of the depressor septi nasi muscles, traction on the lower lateral crus has much less effect on upper lip elevation.

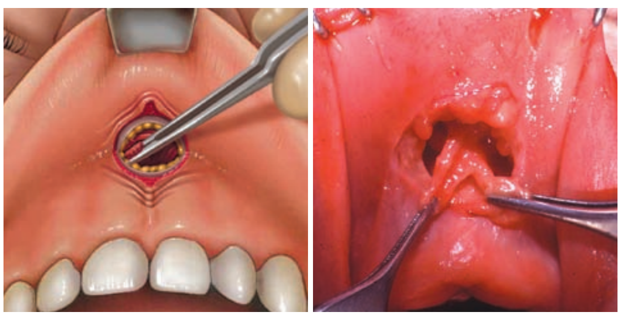
Our operative technique for dissection and transposition of the depressor septi nasi muscles includes the following steps.



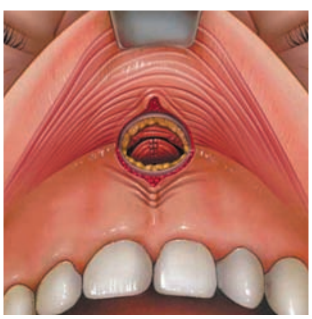
An 8 to 10 mm horizontal incision in the upper labial sulcus is centered on the frenulum.



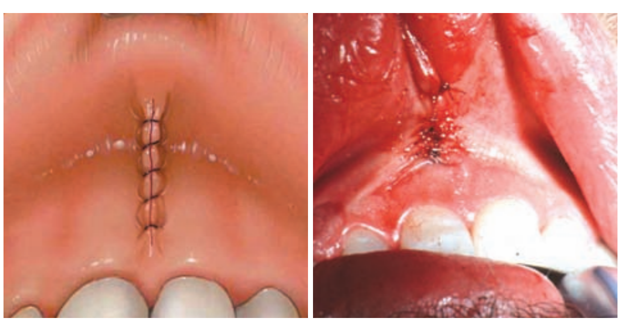
The depressor septi nasi muscle–orbicularis oris muscle junction is exposed. The distal depressor septi muscle is then dissected using needle-tip electrocautery.



The depressor septi nasi muscles are released near their origin with the orbicularis oris muscle (type I) or periosteum (type II).



The depressor septi nasi muscle is transposed, and the cut ends are sutured together with 4-0 chromic catgut sutures.



The horizontal intraoral incision is closed vertically, thereby lengthening the upper lip.

A columellar strut graft is commonly used when the depressor septi nasi muscle is released to unify and support the tip complex.

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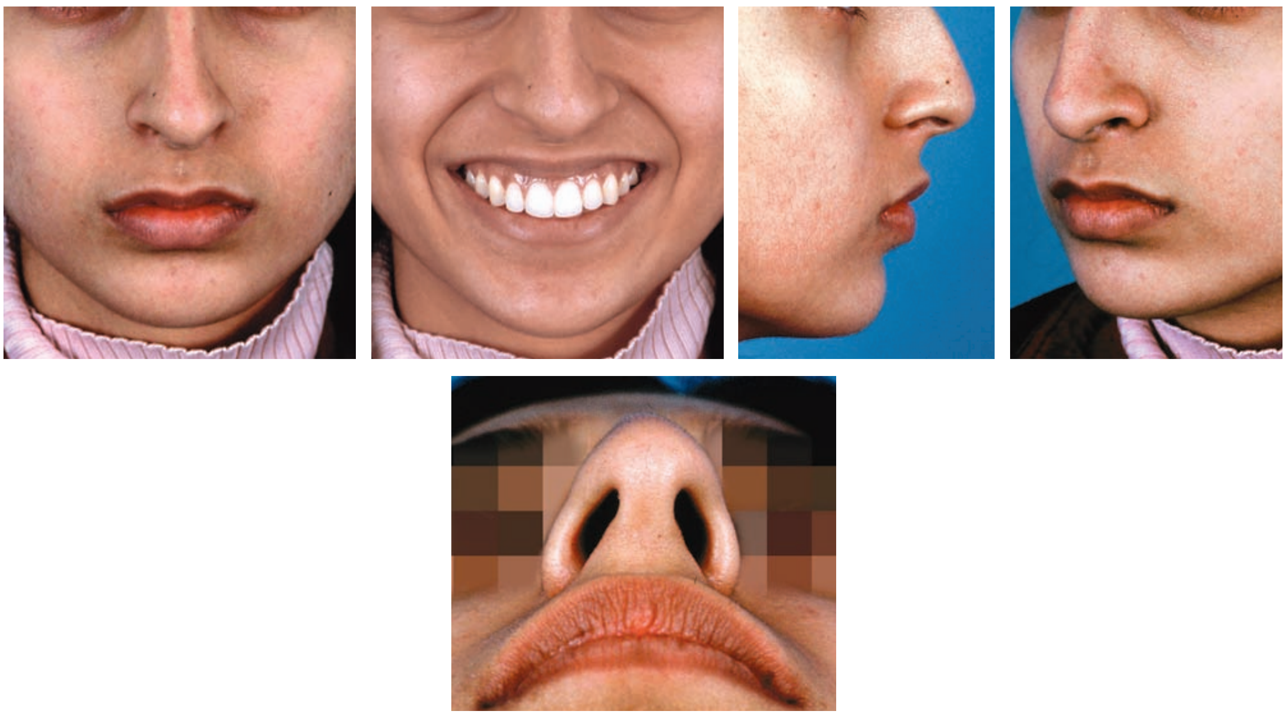
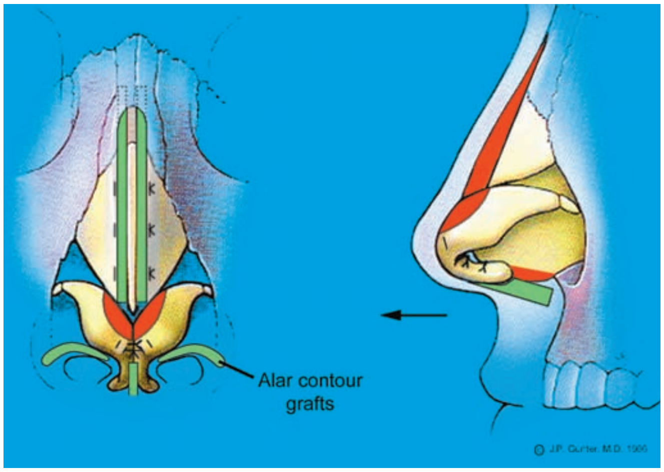
CASE ANALYSIS

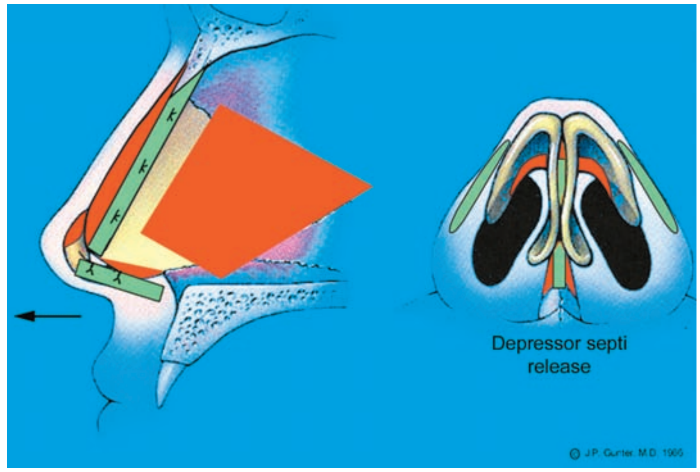


This primary rhinoplasty patient requested aesthetic correction of her nose. Specifically, she was concerned with her dorsal hump, inadequate tip projection, short upper lip, and narrow midvault area with a high dorsal deviation. The frontal view showed that she had Fitzpatrick type III skin with adequate facial proportions. She had thin skin and narrow dorsal aesthetic lines with a C-shaped dorsal deviation of the nasal tip to the left. Asymmetrical alar flaring (more prominent on the right than the left) and an asymmetrical bulbous tip were noted. The frontal and animated frontal views demonstrated an active depressor septi muscle that shortened the upper lip and depressed the nasal tip. The lateral view showed a high radix with a 5 mm dorsal hump and excess tip projection and length with a short upper lip. The patient had a nasolabial angle of 90 degrees. The oblique and overhead views confirmed dorsal midvault narrowing and deviation. The basal view revealed that she had alar notching bilaterally with periapical hypoplasia and a wide columellar base.

The operative goals included the following:

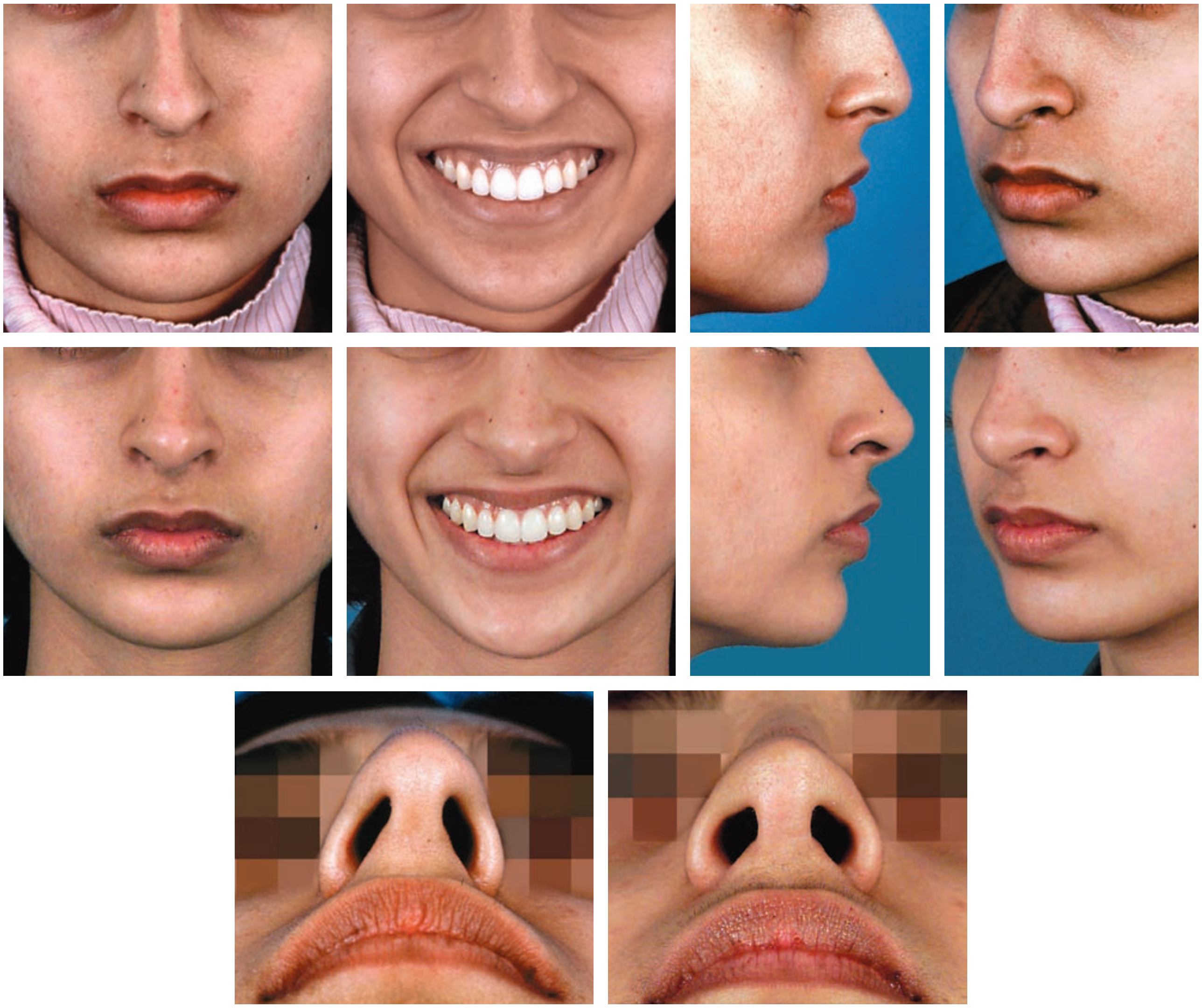
- Reduce the dorsal hump.
- Straighten the dorsally deviated nose.
- Widen and straighten the dorsal aesthetic lines.
- Decrease tip projection and refine the nasal tip.
- Dissect and transpose the depressor septi nasi muscles to improve the nasal tip–upper lip relationship.





Surgical Plan

1. Perform an open approach with a transcolumellar incision and infracartilaginous extensions.
2. Perform a component dorsal hump reduction (reduce the dorsal hump by 5 mm).
3. Reconstruct the septum and harvest septal graft.
4. Place a bilateral spreader graft using three 5-0 PDS horizontal mattress sutures to straighten and strengthen the nasal dorsum and widen the dorsal aesthetic lines.
5. Preserve a 6 mm alar rim strip with a cephalic trim.
6. Secure the columellar strut with 5-0 PDS intercrural sutures.
7. Place interdomal and transdomal sutures for tip refinement using 5-0 PDS sutures.
8. Place bilateral alar contour grafts to correct alar notching.
9. No nasal osteotomies.
10. Dissect and transpose depressor septi nasi muscles through a transoral incision.



The patient is shown 2 years postoperatively, with a straight dorsum and wider dorsal aesthetic lines. She has improved tip refinement. The lateral view reveals a straight dorsum and refinement and a nasolabial angle of 95 degrees. The oblique and overhead views show a straight nose with good dorsal aesthetic lines. The basal view shows correction of the alar notching, a narrower columella, and a straightened nasal tip.

KEY POINTS

- The depressor septi nasi muscle can accentuate a drooping nasal tip and short upper lip on animation.
- The plunging nasal tip is a difficult problem in rhinoplasty. It is accentuated by an active depressor septi nasi muscle and diagnosed by a drooping nasal tip and shortened upper lip during animation (smiling). Preoperative diagnosis and operative techniques for correction of the depressor septi nasi muscle can enhance the lip–tip relationship in rhinoplasty.
- Three variations of the depressor septi nasi muscle were delineated: type I, inserted fully into the orbicularis oris muscle (62%); type II, inserted into periosteum and incompletely into the orbicularis oris muscle (22%); and type III, no or rudimentary depressor septi nasi muscle (16%).
- Division of the depressor septi nasi muscle is a valuable adjunct to rhinoplasty in patients with a type I or II muscle variant and can be identified in a preoperative evaluation with a smile test.
- In our study 32 patients were identified preoperatively with an active depressor septi nasi muscle, diagnosed by a drooping nasal tip and shortened upper lip on animation. This subgroup underwent dissection and transposition of the depressor septi nasi muscle during rhinoplasty, with correction of the deformity in 100% of cases.
- In all patients with an active depressor septi nasi muscle preoperatively, a depressor septi nasi muscle was identified.
- In appropriately selected patients, transnasal release or transoral dissection and transposition of the depressor septi nasi muscle enhances the tip–upper lip relationship, provides relative upper lip lengthening, gives relative fullness to the upper lip, and maintains tip rotation/projection on animation.
- A transnasal approach is used in most cases to release the depressor septi nasi muscles. In patients with tethering of the frenulum, a transoral approach was performed to provide additional length to the upper lip.
- A columellar strut graft is commonly used when the depressor septi nasi muscle is released to unify and support the tip complex.

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Spreader Flap and Spreader Graft

Ronald P. Gruber ▪ Patrick O. Lang ▪ Thomas Satterwhite ▪ Stephen W. Perkins

One of the many problems in rhinoplasty involves the middle third of the nose, which comprises the upper lateral cartilages. For decades the problem of a collapsed middle third was not recognized, nor was its impact on the airway appreciated—the fact that the upper lateral cartilage formed the basis for valves that affect inspiratory flow. The importance of dorsal aesthetic lines, which are in part made up by the middle third of the nose, was also not recognized. Sheen[1] provided one of the best comprehensive analyses of that aspect of the nose, along with a solution—the spreader graft—a technique that would correct both the aesthetic and functional problem of a collapsed middle third of the nose that was a direct result of a humpectomy. Others contributed to its development.[2-9] Once it was recognized that there is a need for cartilage to reconstruct the middle third of the nose after a humpectomy, the next challenge was finding more convenient sources of cartilage.

The middle third of the nose is made up of the upper lateral cartilages and constitutes the internal valve.

BACKGROUND

The concept of trying to preserve the upper lateral cartilages in a primary rhinoplasty and using it to function as a spreader graft, thereby minimizing the need to harvest additional cartilage, has a long history. Many surgeons have contributed to the development of that concept.[9-20] The procedure became popular once we realized that the spreader flap would be much more successful if the flap was not overscored, as was done in the early years. Overscoring causes the flap to be

too narrow, and it will not completely widen the middle third of the nose. When only scored at the caudal end, the flap is much more robust and can function as a spreader graft. We have reviewed the spreader flap procedure on prior occasions.[21-23]

By using a spreader flap instead of a spreader graft to reconstruct the middle third of the nose, no donor cartilage is required.

INDICATIONS AND CONTRAINDICATIONS

The spreader flap is indicated in any primary rhinoplasty case in which there is even a small hump. If the hump is too small, however, and it appears that it will not be possible to fold over the upper lateral cartilage, the spreader flap is contraindicated. Spreader flaps are seldom indicated in secondary cases because patients presenting for secondary surgery usually do not have humps. If they do, however, there is no reason not to use a spreader flap.

The spreader flap can be used in any primary rhinoplasty case in which there is an adequate dorsal hump.

The spreader graft is indicated in a primary case when there is an inspiratory airflow obstruction as a result of middle vault pathology and it appears that a spreader flap is not possible or the patient does not have a hump. It is indicated in all secondary cases when there is a diagnosis of internal valve obstruction and/or there is physical collapse of the middle third or the nose has an inverted-V deformity.

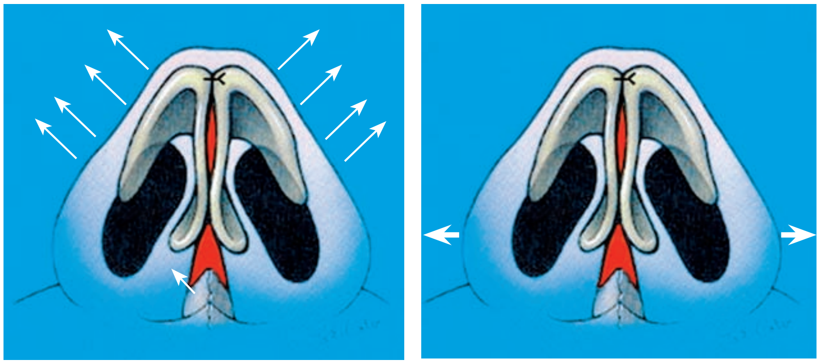
A spreader graft is contraindicated, or its efficacy is debatable, when the middle vault appears to be intact and there is some other cause of inspiratory airflow obstruction. Palpating the middle third of the nose to assess its integrity, observing what deep inspiration does to the middle vault, and the use of nasal strips (discussed later) all help to determine whether a spreader graft should be used.

The width and shape of the spreader flap are controlled by sutures and scoring.

PREOPERATIVE ASSESSMENT AND PLANNING

The surgeon should assess the patient's airway before performing a spreader flap or spreader graft. Observation alone, particularly in a secondary rhinoplasty patient, will reveal whether the middle third of the nose is narrow (such as in an inverted-V deformity). Palpation of the middle third also gives the surgeon some idea of how vulnerable the upper lateral cartilages are to collapse. Performing the Cottle maneuver (spreading the alae apart with the fingers and noting an improvement in inspiratory flow) gives one an approximate measure of airflow.

One of the best ways to assess the nasal airway, however, is with nasal strips (such as Breathe Right strips). For either a primary or secondary patient, with or without symptoms of airway obstruction, a nasal strip is placed in the middle third of the nose and he or she is asked if the airflow is improved, worsened, or not any different. That nasal strip is removed and another is applied to the nasal rims to assess the external valves, and the patient is asked the same questions.



Nasal strip Cottle

The nasal strip works as well or better than the Cottle maneuver, because the tape applies outward pressure throughout, not just at the cheek level. The nasal strip is in effect a mock test for what a spreader graft is likely to do. The patient is then categorized as shown below.

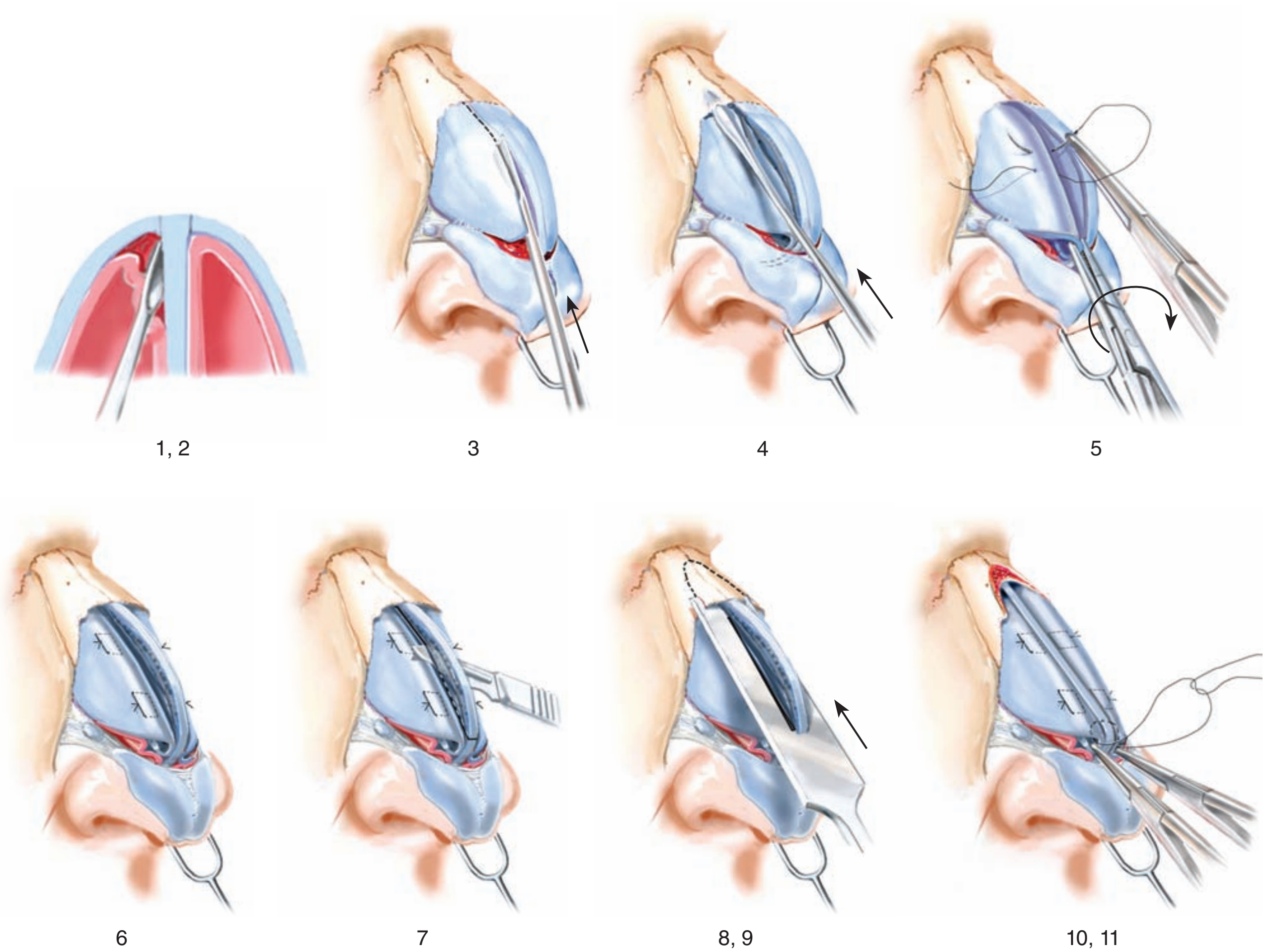
Classification of Nasal Valve Obstruction With the Use of Nasal Strips

BR 0	No improvement or change in airflow
BR I	Improvement with nasal strip on middle third
BR II	Improvement with nasal strip on rims
BR III	BR I and BR II

One of the best ways to assess the nasal airway is with nasal strips.

Planning for the spreader flap does not require any special maneuvers. However, in the case of a spreader graft in a secondary case, the source of cartilage is an important consideration. Septal cartilage is ideal but is often unavailable because it was used in a prior procedure or is required for more important tasks, such columellar struts and lateral crural struts. Therefore ear cartilage should be considered. The concha cymba of the ear is large enough that when split down the middle will make two spreader grafts. The ribs also make an excellent donor site.

OPERATIVE TECHNIQUE: SPREADER FLAP



The operative technique for the spreader flap is as follows:

1. Open the nose.
2. Elevate the mucoperichondrium from the anterior septal angle.
3. Release the upper lateral cartilages from the dorsal septum.
4. Disarticulate the upper lateral cartilages from underneath the nasal bone.
5. Fold over the upper lateral cartilages with a clamp on the caudal end.
6. Apply mattress sutures of 5-0 PDS to narrow the flap.
7. Resect the cartilaginous septal dorsum with a knife from cephalic to caudal end.
8. Resect the bony hump with an osteotome (approximately 1 cm wide).
9. Rasp the bone with a push rasp (going from caudal to cephalic end).
10. Secure the spreader flaps to the dorsal septum with 5-0 PDS sutures.
11. Taper the caudal end of the spreader flaps as needed by scoring the dorsal aspect of the spreader flaps.

Note how the elevator gets under (deep to) the bone to free the upper lateral cartilage.

When the upper lateral cartilage is folded over, it makes a sufficiently wide structure to comprise the middle third of the nose.

If the flaps will not fold over because the hump is too small, the surgeon should switch to spreader grafts. If the flaps have been made too narrow by aggressive scoring, a spreader graft should be added. If the cephalic end of the spreader flap (at the open roof) falls down because of aggressive release of the upper lateral cartilages from the underside of the bone, the spreader flap should be sutured to the contralateral spreader flap.

Spreader grafts are ideal for secondary surgery on noses that have collapsed at the middle third. They do work well in primary rhinoplasty cases if so desired.

CASE ANALYSES: SPREADER FLAP

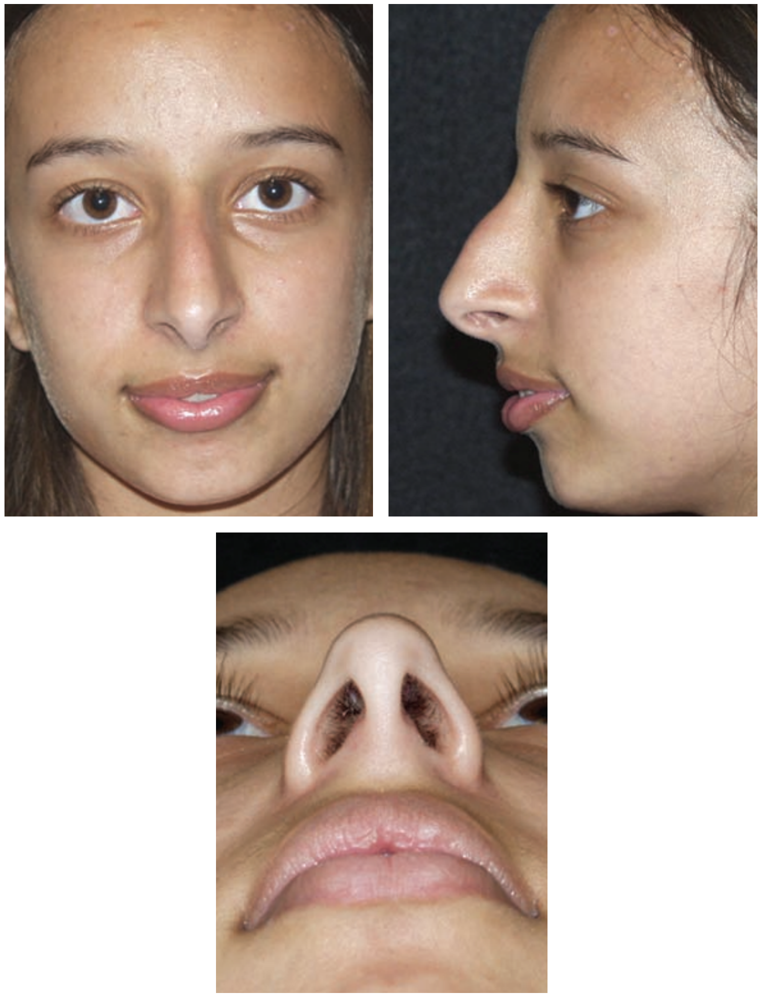
This young woman requested correction of her dorsal hump, broad nasal bones, broad nasal tip, and nostril show.

Surgical Plan

1. Use an open approach.
2. Reduce dorsal hump.
3. Craft and place spreader flaps.
4. Perform bilateral osteotomies.
5. Employ lateral crura, interdomal, and transdomal suturing.
6. Preserve the cephalic lateral crura.
7. Place alar contour rim grafts.
8. Perform alar base excision.
9. Perform a submentoplasty.

At 11 months postoperatively there is improvement to the bony width, tip width, and nostril show. The middle third of the nose exhibits a normal width. The dorsal aesthetic lines appear satisfactory. However, on lateral view the nose appears slightly short. On basal view there is a slight concavity of the left rim. Her nasal function is normal.

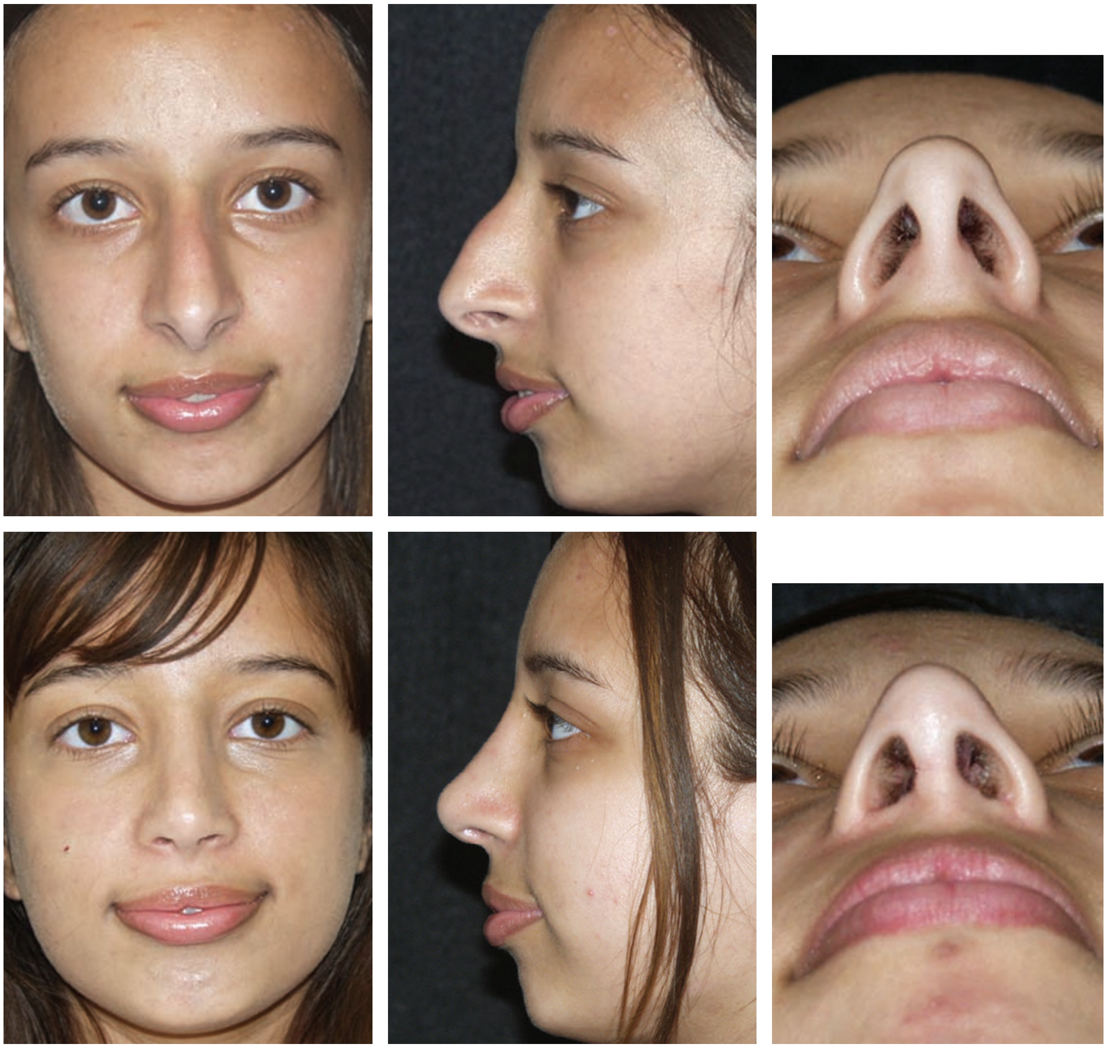
At the time of the dorsal hump reduction, the fundamental structure of the middle third of the nose should be preserved for both aesthetic and functional reasons.



This young woman presented with a hanging columella, broad nasal bones, long nose, dorsal hump, and slightly broad tip.

Surgical Plan

1. Use an open approach.
2. Shorten the caudal septum.
3. Reduce dorsal hump.
4. Craft and place spreader flaps.
5. Perform bilateral osteotomies.
6. Employ lateral crural, interdomal, and transdomal suturing.
7. Place a columellar strut graft.
8. Perform alar base excision.
9. Perform a septoplasty.



At 13 months postoperatively improvement to the bony width, hanging columella, and length of the nose is evident. The middle third of the nose appears of normal width, and the dorsal aesthetic lines seem reasonable. However, the overall nasal width is slightly broad. On lateral view the nose is slightly overrotated. On basal view the footplates have collapsed medially somewhat. Her nasal function is normal.

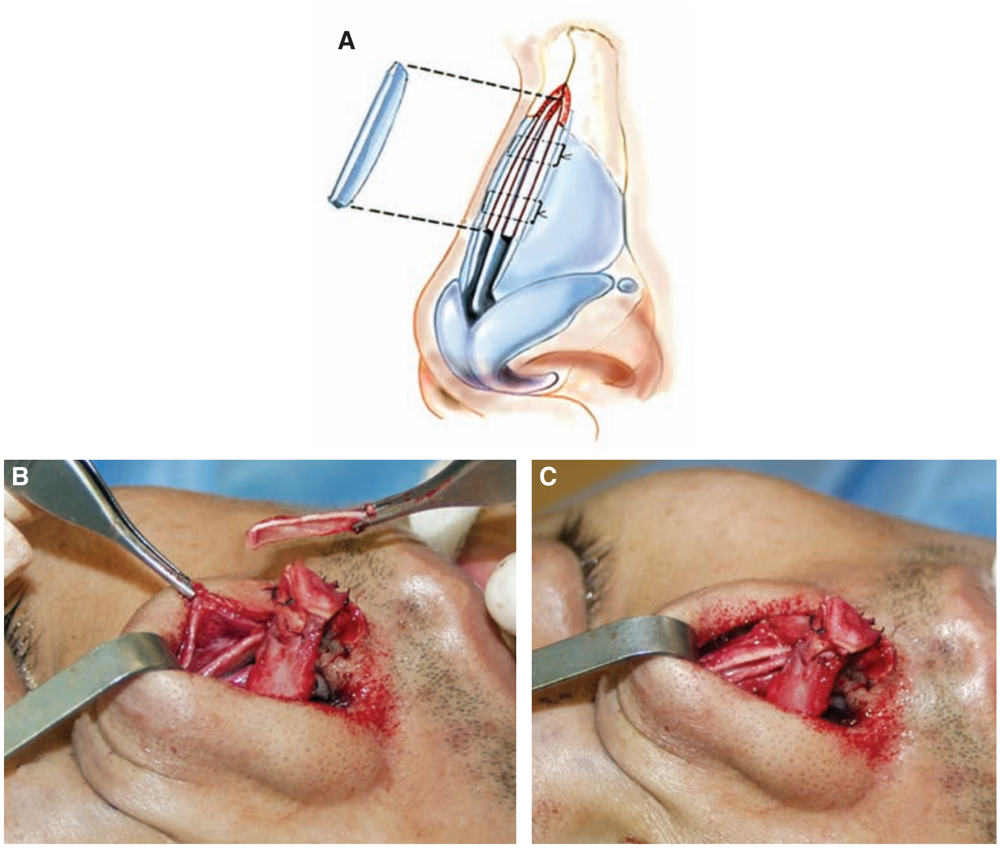
This 40-year-old woman requested correction of her broad tip, wide nasal bones, turbinate hypertrophy, and dorsal hump.

Surgical Plan

1. Use a closed approach.
2. Reduce dorsal hump.
3. Prepare and place spreader flaps.
4. Perform lateral and medial osteotomies.
5. Place a columellar strut graft.
6. Perform a suture tip-plasty with cephalic lateral crus resection.
7. Place a radix graft.
8. Perform a septoplasty.

One year postoperatively there is considerable improvement in the problems addressed. Note that the integrity of the middle vault has been maintained. The patient's airway provides a more than satisfactory flow.

OPERATIVE TECHNIQUE: SPREADER GRAFT



The operative technique for the spreader graft includes the following:

1. Cartilage is acquired from the septum, ear, or rib *(A)*.
2. A typical spreader graft will need to be approximately 2 cm long, 4 to 5 mm wide, and 2 mm thick. The graft can be made longer and shortened as needed to fit.
3. The upper lateral cartilage is moved out of the way so the graft can be inserted *(B)*.
4. The graft should fit flush in the space between the septum and upper lateral cartilage *(C)*.
5. The graft is secured with one or two No. 30 needles.
6. The graft is sutured to the dorsal septum with 5-0 PDS or 5-0 Vicryl sutures.
7. If ear cartilage is used, the concha cymba is harvested, splitting it down the middle and applying each half to one side of the septum, concave side down.

A spreader graft or spreader flap will preserve the integrity of the middle third of the nose.

CASE ANALYSES: SPREADER GRAFT

This 63-year-old woman requested refinement of her broad nasal tip and dorsal hump.

Surgical Plan

1. Use a closed approach.
2. Perform a septoplasty.
3. Make alar base excisions.
4. Perform a suture tip-plasty, including cephalic lateral crural resection.
5. Craft and place a columellar strut graft.
6. Reduce dorsal hump.
7. Place radix graft.
8. Place crushed dorsal only graft.
9. Narrow her flared nostrils.

Ten months postoperatively there is considerable improvement in the problems for which the patient sought correction. The integrity of the middle third of the nose and the internal nasal valves has been maintained, and her airway functions quite well.

This woman had undergone a prior rhinoplasty that left an inverted-V deformity, a nose deviated to the left, a pointed nasal tip, and nasal airway obstruction. On lateral view there was some fullness in the nasion region and alar retraction. The basal view revealed that her tip was too pointed.

Surgical Plan

1. Use an open approach.
2. Perform a septoplasty.
3. Create spreader grafts from ear concha.
4. Place an interdomal graft.
5. Craft a tip graft from ear cartilage.
6. Place alar contour rim grafts.

The patient is shown 15 months postoperatively; the inverted-V deformity has been corrected, her nasal airway function is improved, the nose is straighter, and the nasal tip is not as pointed. However, on basal view there are some telangiectasia of the infratip lobule, and the footplates are deficient.

COMPLICATIONS

One of the potential complications of these procedures is making the spreader flaps too wide. The width is controlled by how tight the sutures are made. If the caudal end of the flaps (approaching the lateral crura) are not tightened sufficiently with sutures or are not scored along their dorsum to achieve the same type of narrowing, the supratip area will be too wide. In that case, increased tip width postoperatively may be attributed to failure to control the lower lateral cartilages, when in fact it may have resulted from failure to control the caudal end of the upper lateral cartilages.

When tip width is increased postoperatively, this may be attributed to failure to control the lower lateral cartilages when in fact it may be caused by failure to control the caudal end of the upper lateral cartilages.

Another potential complication is making the spreader flaps too narrow. When the spreader flap concept was first introduced in the 1990s, it was suggested that the entire length of the spreader flap be scored along its dorsum to narrow it. However, in many cases doing so resulted in spreader flaps that were too narrow; these flaps failed to provide adequate width for the middle third of the nose and failed to provide adequate airway function.

CONCLUSION

The middle third is an important part of the nose. It contributes to the dorsal aesthetic line and contains the internal valves formed by the upper lateral cartilages. A humpectomy in primary rhinoplasty without any consideration of preserving the valves may result in an unaesthetic problem such as an inverted-V deformity and functional nasal airway obstruction.

By preserving the upper lateral cartilage at the time of a dorsal hump reduction and folding it over as a flap, the middle third of the nose is preserved.

In primary cases a humpectomy can be done with preservation of the upper lateral cartilages. These cartilages are then folded over to make spreader flaps. The spreader flaps maintain the proper aesthetic width of the middle third of the nose and maintain the patency of the internal nasal valve. The use of spreader flaps precludes the need for spreader grafts in almost all cases. Donor cartilage that

would otherwise be used to make spreader grafts can be saved for other purposes. However, in secondary cases in which the middle third has collapsed, leaving both an aesthetic and functional problem, spreader grafts are ideal to re-create the integrity of the middle third of the nose. Nasal strips are an excellent test for internal nasal valve function.

KEY POINTS

- The middle third of the nose is made up of the upper lateral cartilages and constitutes the internal valve.
- By using a spreader flap instead of a spreader graft to reconstruct the middle third of the nose, no donor cartilage is required.
- The spreader flap can be used in any primary rhinoplasty case in which there is an adequate dorsal hump.
- The width and shape of the spreader flap are controlled by sutures and scoring.
- One of the best ways to assess the nasal airway is with nasal strips.
- Spreader grafts are ideal for secondary surgery on noses that have collapsed at the middle third. They do work well in primary rhinoplasty cases if so desired.
- At the time of dorsal hump reduction, the fundamental structure of the middle third of the nose should be preserved for both aesthetic and functional reasons.
- A spreader graft or spreader flap will preserve the integrity of the middle third of the nose.
- When tip width is increased postoperatively, this may be attributed to failure to control the lower lateral cartilages when in fact it may be caused by failure to control the caudal end of the upper lateral cartilages.
- By preserving the upper lateral cartilage at the time of a dorsal hump reduction and folding it over as a flap, the middle third of the nose is preserved.

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The Black Nose

Rod J. Rohrich ▪ Arshad R. Muzaffar ▪ Ashkan Ghavami

Rhinoplasty has become increasingly popular among black patients. As our surgical acumen has improved in ethnic noses, fear of the stigma associated with an artificial black rhinoplasty has lessened. Although rhinoplasty is a technically demanding surgical procedure in any patient, it can be especially challenging in a black patient. Surgical success in a black rhinoplasty patient requires an appreciation of ethnic concepts of beauty and the unique anatomic characteristics of the black nose. These general anatomic characteristics are compounded by the wide-ranging variations in individual anatomy and the relationship of the nose in relation to the face. Attaining consistent aesthetic results is significantly more complicated in black rhinoplasty patients than in white patients.

The black nose is characterized by a wide and low dorsum, decreased tip projection, an ill-defined tip, greater alar flaring and/or interalar distance, diminished nasal length and height, an acute columellar-labial angle, and a low radix.

Understanding the patient's desires and motivation for surgery is critical. A pragmatic, systematic analysis of the black nose and the techniques commonly used to modify it while maintaining or achieving facial aesthetic harmony will be discussed. As black rhinoplasty is becoming more acceptable, patients may reference attractive as well as more displeasing nasal appearances in popular black celebrities. It is not uncommon for patients to bring in images. The types of images

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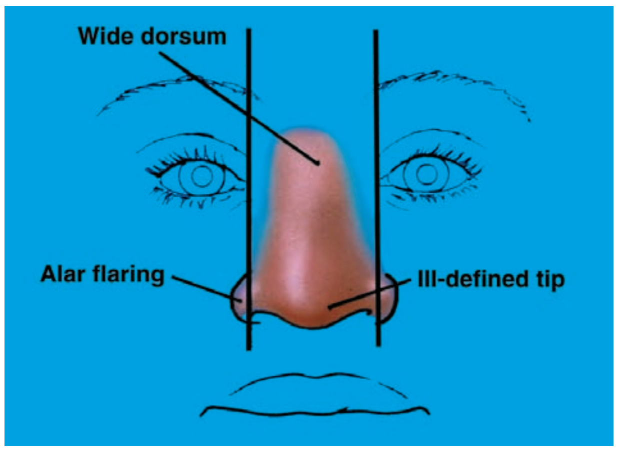
Chapter modified from Rohrich RJ, Muzaffar AR. Rhinoplasty in the African-American patient. Plast Reconstr Surg 111:1322-1139, 2003.

shown may actually be helpful in a surgeon's assessment of whether the patient has a realistic level of expectation. Frequently patients describe a celebrity's nose they admire and almost always indicate ones they fear that their nose resembles.

Consideration of the evolving black concepts of beauty, the unique anatomic characteristics of the black nose, and specific patient desires as well as fears are essential to surgical success.

NASAL AESTHETICS IN THE BLACK PATIENT



Nasofacial harmony and balance are universal elements of beauty and are the ultimate objectives of any surgical plan regardless of the patient's ethnicity.[1-3] In formulating a surgical plan, nasal analysis is an essential first step. The standards or aesthetic norms used as references in this analysis have long been based on the white female face. In relation to this reference, the black nose is generally characterized by a wide, low dorsum, poor tip projection, lack of tip definition, significant alar flaring and/or increased interalar width, a shorter radix-to-tip distance (nasal length), an acute columellar-labial angle, and a low radix.[4-13] There is a considerable degree of variability in the black nose, given the diverse ethnic backgrounds of blacks.[10,14]

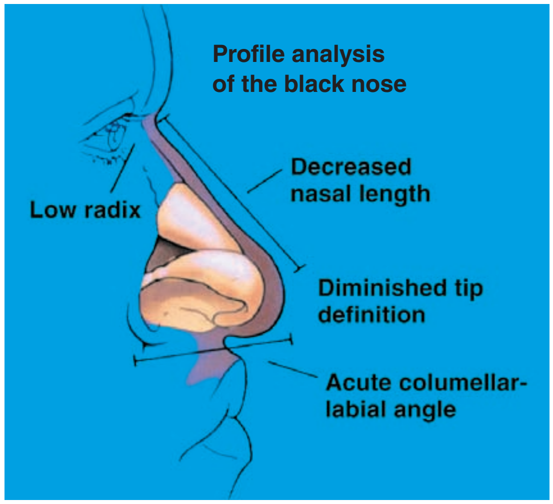
The limitless combination of the above characteristics and degree of magnitude present require the rhinoplasty surgeon to be versed in correcting all and any imbalances that present. The imbalance of the soft tissue to cartilage frame mandates attention to proper technical execution that strengthens and shapes the frame while reducing and improving adherence of the soft tissue sleeve.[15]

An appreciation of ethnic concepts of beauty and nasofacial harmony and aesthetic balance is a prerequisite for success in treating black rhinoplasty patients.

As emphasized by Sheen and Sheen[16] and Gunter,[17] standards of beauty in our society have been influenced by the mass media and reflect the idealized Northern European characteristics, which in respect to the nose include a straight, narrow bridge, a well-defined projecting nasal tip, refined alae, and a nasolabial angle of approximately 90 to 95 degrees in men and 95 to 110 degrees in women. In contrast to the traditional black concepts of beauty, Millard[18] described the aesthetic white female face as having clear, pale, and smooth skin; large, widely spaced soft eyes with long lashes; a small, slim nose; high cheek bones; and a medium-sized mouth with gentle lips that are not too thick.

Ethnic groups may feel that their "nonstandard" appearance sets them apart. The aesthetic objectives of the black rhinoplasty patient can usually be broadly conceptualized as (1) to achieve an appearance that more closely approximates the predominant standard of beauty in our society (that is, the "white ideal") or (2) to attain a more attractive nose that retains its ethnic character. More commonly, black/multiracial patients want to undergo clear visual changes without creating distortion of ethnic features to the point of an obvious rhinoplasty. Many prefer that it not be readily apparent that they have undergone rhinoplasty. It is imperative that the surgeon understand this distinction in the preoperative assessment of a black rhinoplasty patient to avoid any postoperative problems that may result from patient misunderstanding. Furthermore, clarification of this objective will help to establish preoperatively whether the patient is attempting to transform or erase his or her ethnic features, which may be impossible and is unwarranted based on anatomic limitations.

Patients who have unrealistic goals will seldom be satisfied with the postoperative result, and a prudent surgeon will decline to proceed with treatment. In addition, the surgeon must not assume that the patient desires a nose that resembles the white ideal; this is rarely a requested or realistic outcome.



The black nose typically has a short columella, a broad, flat dorsum, slightly flaring alae, and a rounded tip with ovoid, horizontally oriented nares. The upper lip is highlighted by a prominent Cupid's bow and fullness over the lips. Bimaxillary protrusion is common. It is obvious from this description that it would be an error to apply the standards of white beauty to the black patient. Therefore the plastic surgeon managing the black rhinoplasty patient must understand and appreciate what constitutes black facial aesthetics. Working within and not against the context of these features will ensure a racially congruent and natural appearing surgical result.

By recognizing the classic black nasofacial traits, the rhinoplasty surgeon can work within this context of nasal characteristics by creating improved nasal harmony and avoiding a racially incongruous and artificial result.

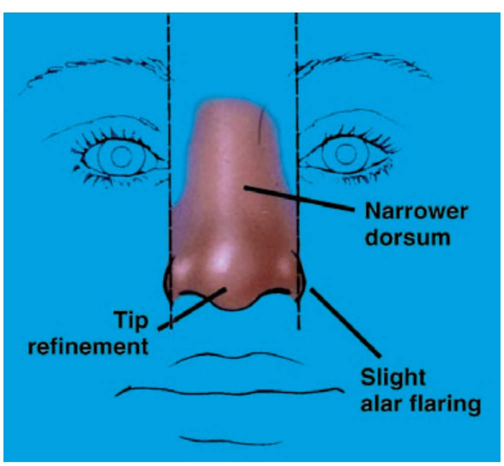
As Farkas[19] delineated, the aesthetic face is not divided into equal thirds or fourths. Rather, the lower face has a greater vertical dimension than the midface, which in turn has a greater vertical dimension than the upper face.[20,21] These proportions are amplified in black facial features. Black patients commonly have bimaxillary protrusion. However, it is important to identify any underlying skeletal disproportion and point this out to the patient preoperatively.

The treatment plan should not be based on a frontal photograph alone. According to Byrd and Hobar,[22] the ideal nasal length measured from the radix to the tip-defining points should approximate the distance from the stomion to the menton. The nasal length measurement should be derived from a clinical examination and a profile view of the patient. Nasal projection is defined as the distance from

the alar-cheek junction to the nasal tip and is approximately 0.67 times the ideal nasal length in white patients. Nasal projection is usually less in black patients and is approximately 0.5 times the nasal length.

Ultimately, ideal aesthetic nasal and facial measurements and proportions for the black nose should be defined as they have been for the white nose.[23] Porter and Olson[14] described average values for anthropometric measurements and proportions in young black women. Their analysis revealed that, compared with the white ideal, their study population demonstrated a decreased columellar-lobule ratio, greater variability in the nasal base shape, an alar base width wider than the intercanthal distance, a smaller nasolabial angle, and an increased nasofacial angle. In an attempt to classify the subjective features of the black female nose, Porter and Olson[14] grouped their patients by nasal base shape (trapezoidal, triangular, or oval), dorsal height (high or low), and nostril orientation (inverted, vertical, and horizontal). These classifications proved to impart meaningful information regarding many of the measured anthropometric indices. Similar studies that define average values for this patient population will lead ultimately to the description of ideal aesthetic measurements and proportions for the black rhinoplasty patient.[23]

Proper nasal alignment will help to maintain ethnic characteristics in black rhinoplasty patients. Broadbent and Matthews[24] described the ideal nasal alignment as a lateral attachment of the ala to the cheek that lies within a vertical line drawn through the medial canthus. Nasal features can be improved without altering ethnic appearance by bringing the elements of the nose closer to this boundary. Given the differences relative to the white standard and the variability of the features of the black nose, an appreciation of and sensitivity toward black nasofacial aesthetics is essential for obtaining consistent aesthetic results in this patient population.



The overall goals for rhinoplasty in black patients are usually to achieve the following:

- Nasofacial harmony and balance
- A narrower, straight dorsum
- Increased dorsal height
- Enhanced tip projection and definition
- Subtly reduced alar flaring
- Decreased interalar distance

Narrowing the interalar distance or correcting alar flaring can improve nasal appearance without disturbing the ethnic character of the nose. It is important to preserve the natural C-shaped curvature to the lateral alae as it joins the cheek.

ANATOMIC VARIATIONS

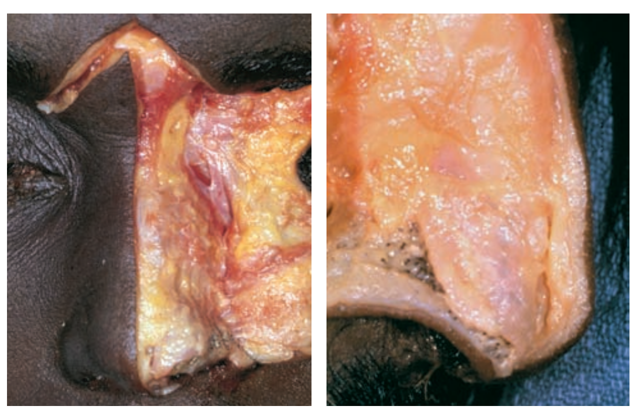
Descriptions of anatomic distinctions between the white nose and the black nose abound in the literature. Among them are a number of myths. As Ofodile et al[9-12] described, the many variations in black nasal anatomic features can be attributed to the triethnic background of many black Americans: African, European, and Native American. Patients may have a multiracial admixture of Hispanic and Asian descent as well. Thus individualized anatomic diagnosis and surgical planning are as essential for black patients as for other patients. Anatomic variations in white and black patients are summarized in the table.

Anatomic Variations in White and Black Individuals

	Whites	Blacks
Skin	Thin	Thick
Alar cartilage		
Size	Large	Large
Support	Strong	Strong
Alar base	Slight alar flaring	Excess alar flaring; increased interalar distance
Nasal pyramid		
Nasal bones	Long	Long but flattened
Base	Narrower	Wide
Dorsum	Thin	Broad/depressed

Skin

The skin, especially in the tip area, is notably thicker in the black patient. The tip is usually flattened, bulbous, and ill defined.

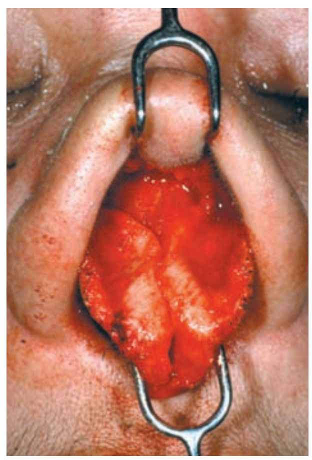


The skin is thick, sebaceous, and relatively inelastic with increased subcutaneous fibrofatty tissue present above the lower lateral cartilages, obscuring tip definition. This fibrofatty layer often measures 2 to 4 mm in thickness.

In some cases, the fibrofatty tissue should be selectively thinned; subdermal defatting should be avoided to prevent compromise to nasal skin circulation. It is important to recognize that not all black noses present with thick skin. When thin skin is present, less aggressive maneuvers are warranted particularly at the tip complex.

The skin and subcutaneous tissues of black patients are often quite thick and can be inelastic.

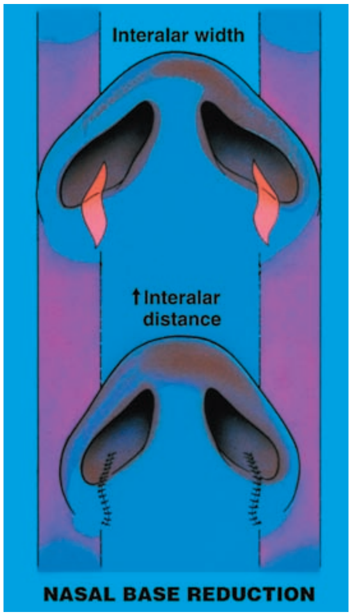
Alar Cartilages

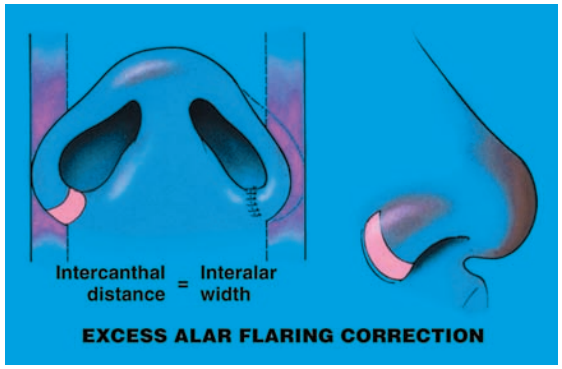


Previously the alar cartilages in black individuals were thought to be thin and weak, affording little support to the overlying heavy skin and fibrofatty unit. However, our own anatomic studies[25] as well as those of Ofodile and James[12] have demonstrated that the alar cartilages in black patients are similar in size to those of white patients. The angle between the medial and lateral crura at the soft triangle is obtuse, and the space is filled with a relative abundance of fat and skin. The anterior nasal spine is underdeveloped in many cases, and along with insufficient medial crura, contributes to the paucity of tip projection.

The alar cartilages are not as typically weak and underdeveloped as once thought.

Alar Base





Alar base abnormalities in the black patient can be defined as one of three entities:

1. Increased interalar distance (excess sill) with the alar bases being lateral to the medial canthal lines
2. Excessive alar flaring, which is characterized by a portion of the ala extending lateral to the alar attachment of the cheek (more than 2 mm)
3. A combination of alar flaring and increased interalar distance, making the correction more challenging

The columella is short and rounded and often hidden on the profile view by heavy overlying alar rims.

The alar bases may exhibit increased interalar distance, alar flaring, or both. When both are present, as often is the case, it is important to be prudent in the degree of correction, since an overresected alar base is one of the telltale signs of poorly performed black rhinoplasty. Alar base resections should be performed at the end of the procedure and not at the initial procedure if there is any doubt regarding their necessity.

Nasal Pyramid

The base of the bony pyramid is widened and the dorsum is low, broad, and often saddlelike. There is a deepened nasofrontal angle that exaggerates the flattened look. The nasal bone's dimensions are similar in height and width.

The striking characteristic is the splaying and lack of vertical projection of the ascending process of the maxilla, which contributes to the low and widened nasal base.[25-27] However, the flat external appearance of the nose is usually caused by a lower dorsal bridge rather than a wide base. For this reason osteotomies and infractures should be carried out judiciously only after the nasal bone length is assessed. A subtle infracture along with dorsal augmentation will create greater improvement in narrowing of dorsal aesthetic lines. However, dorsal augmentation alone can sometimes be required. It is important to note that the bony base in black patients is wider than in whites. The appearance of increased interpupillary distance is one feature that patients may complain about.

The dorsum is usually broad and low with a wide bony pyramid and splayed and shortened ascending processes of the maxillae. Dorsal augmentation with or without osteotomies is usually warranted.

OPERATIVE TECHNIQUE

With growing experience in rhinoplasty techniques and the increased use of autologous tissue for grafting, consistently reproducible results have become attainable in the black rhinoplasty patient. By applying the principles of augmentation rhinoplasty to correct the characteristic features of the black nose, the following techniques have evolved:

A. Increasing tip projection
   1. Autologous columellar strut graft
   2. Suture shaping of medial crura using interdomal and transdomal sutures
   3. Tip grafts: infratip lobular (Sheen), onlay (Peck), combined infratip lobular/onlay (Gunter), and multiple tip graft techniques

B. Increasing tip definition
   1. Transdomal suture technique
   2. Multiple tip grafts, particularly infratip lobular grafts and domal onlay grafts

C. Dorsal augmentation/refinement
   1. Autologous tissue
      - Septal, ear, or rib cartilage
        – Diced cartilage fascia graft technique
   2. Alloplastic implant (not our preferred technique)
   3. AlloDerm or temporal fascia: mostly for contour/camouflaging

D. Alar base surgery
   1. Correction of alar flaring by alar base resection
   2. Decrease of interalar distance by nostril sill excision and medial advancement

A well-planned approach to rhinoplasty is essential to attain consistent results. Each technical maneuver should address each individual component. The following six principles are expected to ensure consistent functional and aesthetic results in blacks[25-27]:

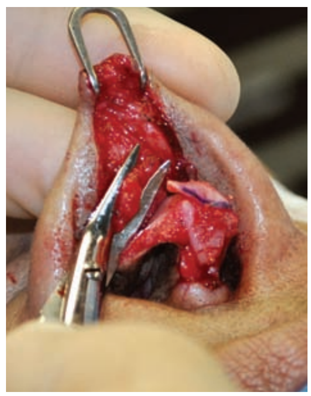
1. Open approach
2. Accurate intraoperative anatomic diagnosis
3. Meticulous hemostasis
4. Routine use of autologous tissue and grafts for dorsal/tip augmentation
5. Selective skin envelope defatting
6. Meticulous wound closure

It should be emphasized that before entering the operating room the surgeon must define the deformity, determine the cause of the deformity, establish realistic surgical goals, and formulate a treatment plan. Once these preparatory steps have been completed, the following technique is used. An open approach is advocated because accurate anatomic diagnosis under direct binocular vision is essential for achieving pleasing and reproducible modifications of the challenging black nasal anatomy. With the patient under general anesthesia, the external nose and septum are injected with 10 ml of 1% lidocaine with 1:100,000 epinephrine, and the internal nose is packed bilaterally with 3.5 inch neuropledgets moistened with oxymetazoline (Afrin).

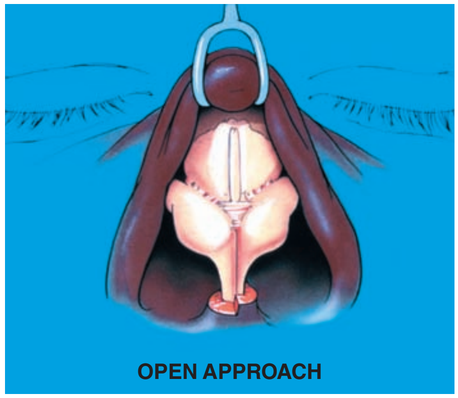
Accurate preoperative analysis and diagnosis are essential to formulating a realistic surgical plan. Consent for possible distant graft sites (ear, rib, temporal fascia) should be obtained. The patient's aesthetic aims must be clearly verbalized and documented. An accurate internal and external nasal examination is essential. An individualized, organized, and realistic operative plan can then be formulated.

Bilateral infracartilaginous incisions along the caudal edge of the lower lateral cartilages are terminated medially at the narrowest portion of the columella and connected with a transcolumellar stair-step incision. This maneuver allows precise wound closure, and the splinting supplied by the underlying medial crural cartilages aids in preventing scar contracture.

The open approach is advocated for accurate intraoperative anatomic diagnosis under direct binocular vision with precise correction of the deformity. It permits more options in the modification of the native tissues, allowing for precise application of suturing techniques and better use of cartilage grafts, specifically mid-columellar struts and tip grafts to increase tip projection and dorsal onlay grafts to enhance the dorsal profile in the black patient.



The skin elevation is begun by dissecting the thin columellar skin off of the caudal edges of the medial crura and intervening subcutaneous tissue. Great care must be taken to avoid transecting the fragile medial crural cartilages. Dissection proceeds from inferior to superior, to the level of the infratip lobule, and then laterally over the lateral crura and medially, stopping at the soft triangle. The soft triangle is dissected last, affording optimal visualization to avoid damage to the vulnerable middle crus of the lower lateral cartilage. Accurate anatomic dissection is achieved by hugging the lower lateral cartilages. The "white sheen" that can be seen indicates the proper dissection plane, leaving all the fibrofatty tissue on the elevated nasal skin flap for selective defatting, if indicated. No subdermal defatting is performed, but the prominent supratip globular, loose fibrofatty tissue can safely be removed before completion of tip-shaping maneuvers and final closure.



The dissection is continued over the upper lateral cartilages and the cartilaginous and bony dorsum up to the root of the nose. This enables retraction of the undermined area, exposing the entire nasal framework.

The soft tissues are elevated from the nasal framework, and the tip cartilages are evaluated and correlated with the preoperative diagnosis. The extent of the nasal tip deformity and paucity of nasal projection are then determined based on direct visualization and the preoperative analysis. Typically, tip projection needs to be significantly increased. The desired tip projection will dictate the dorsal height; therefore any alteration of the dorsum should be performed with the final tip projection in mind. Osteotomies and dorsal augmentation techniques can be performed after or before tip shaping and positioning. However, tip projection is often the limiting step. If dorsal augmentation is performed first (usually the case), then the surgeon should not hesitate to go back and trim or add to the dorsal height according to final tip position.

After the desired tip projection is determined, the dorsum is evaluated. Usually dorsal augmentation is required in the majority of black rhinoplasty patients. However, rasping may be necessary to remove any irregularities and provide a smooth bed on which to place the autologous dorsal graft. Lateral osteotomies are performed if the nasal bones are not weak or excessively short (shorter than 15 mm). When dorsal augmentation is indicated, it is performed after septal reconstruction or septal graft harvest. The dorsal height should be reevaluated after final tip projection is achieved to determine whether further dorsal augmentation or modification is necessary.

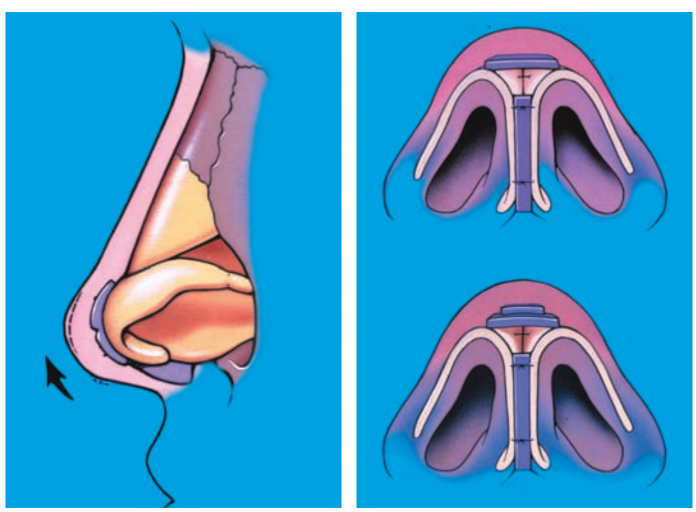
The desired tip projection dictates the appropriate dorsal height. Dorsal augmentation should be performed after septal graft harvest and before setting the final tip projection.

If septal work is required, either to straighten the septum or harvest autologous cartilage grafts, the septum can be approached either from the anterior septal angle through the open approach or through a separate transfixion incision. We prefer to approach it from the anterior septal angle through the open approach.

The use of autologous cartilage grafts is advocated, when such grafts are possible; the use of alloplastic materials is not preferred.

This approach necessitates separating the medial crura to gain adequate exposure. The septum proper is separated from the upper lateral cartilages in a component fashion. There should be no hesitation in performing this step in the black patient because the tip structures need to be reconstructed to establish increased projection. Submucous microfracture and resection of the anterior inferior turbinates can be performed at this time since inferior turbinate hypertrophy is quite common in the black nose. However, outfracture may be all that is necessary. This carries less morbidity.

The septum is ideally approached from the anterior septal angle through the open approach by separating the upper lateral cartilages from the septum in a component fashion.



After the septal cartilage is harvested, osteotomies can be performed in patients (when indicated) to properly align or narrow the nasal base before dorsal augmentation and final tip reconstruction. Attention is directed to the tip for final modification of the tip cartilages and establishment of tip projection. To estab-

lish and enhance tip projection and/or definition, a graduated approach is used.[28] Initially, a columellar strut graft is secured with intercrural sutures; then interdomal and transdomal sutures are used to unify the tip and increase tip projection. These suture techniques are followed by a combined infratip lobular/onlay tip graft and additional double and even triple layered onlay cartilage grafts as required to attain final tip definition and projection.[29] The orientation and strength of the lower lateral crura must be kept in mind when performing suture tip shaping.[30-33] Lower lateral crural struts, alar contour grafts, and/or lower lateral crural turnover flaps may be indicated to reinforce the heavy overlying soft tissue envelope and prevent soft tissue/alar retraction or notching.[34-37]

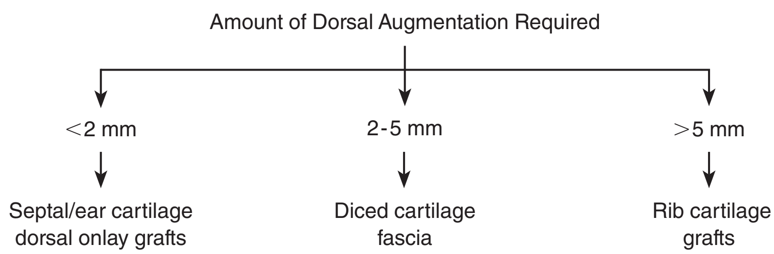
The surgeon should use a graduated approach to increasing tip projection with comprehensive suture tip-shaping techniques and cartilage grafting (for shape and support) as dictated by preoperative nasal analysis and continual intraoperative observation of dynamic structural interactions.

A strong, long bowie knife-shaped strut in the columella both increases the tip projection and augments the columellar-labial angle because black patients usually have a retracted columella as well as decreased tip projection. This graft is placed in a pocket within soft tissue in front of the anterior nasal spine between the feet of the medial crura. The strut and the medial crura are advanced until the desired tip projection is achieved. The medial crura are secured to the strut using intercrural sutures of 5-0 PDS. Interdomal and transdomal sutures are routinely used because of the thick skin and the need for increased tip refinement and projection in black patients.

Before establishing final tip projection, only the excess fibrofatty tissue over the dome area of the lower lateral cartilages is removed. As it is removed, the subdermal plexus must be preserved to prevent postoperative nasal tip necrosis. This maneuver enhances tip definition by decreasing the thickness of the overlying soft tissue envelope. Tip definition is optimally accentuated using a combined infratip/onlay tip cartilage graft.[28] To increase tip projection and definition, multiple combined tip grafts can be fashioned from septal cartilage and are sutured with 5-0 PDS to the middle crura and domal cartilages. However, if more infralobular definition is needed, an infratip graft is used in a similar fashion. These combined grafts give the optimal projection and definition to the black nose with thick skin.

The columellar strut graft is the foundation for tip complex stability and enhanced tip projection.

Meticulous technique must be used when removing excess fibrofatty tissue from the domal, paradomal, and supratip area to preserve the subdermal plexus blood supply and thereby prevent tip skin necrosis.

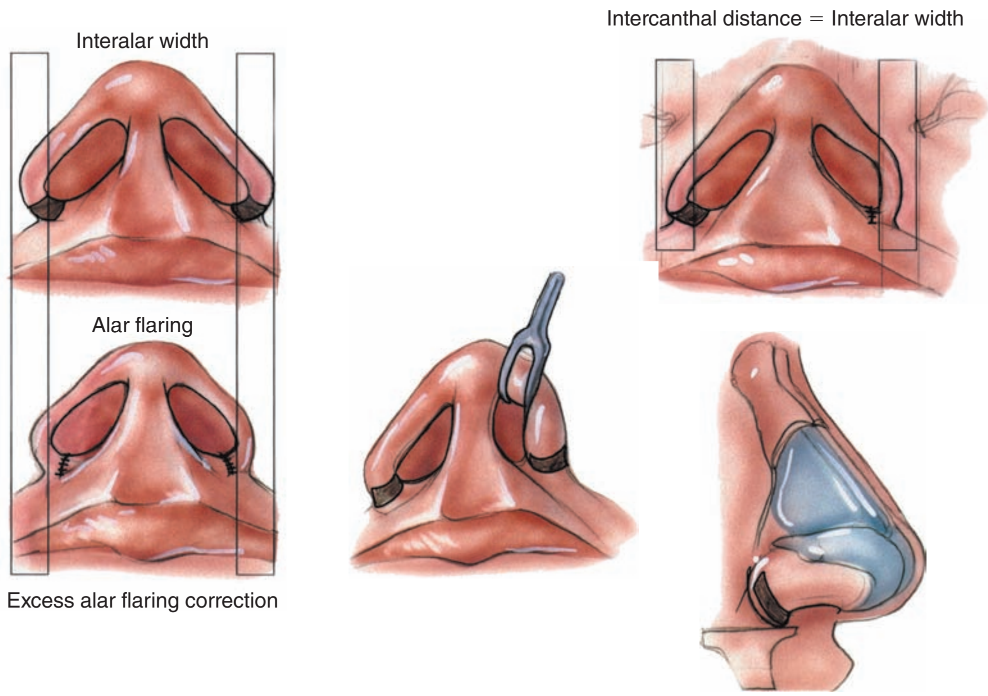


Once the final tip projection is established, dorsal augmentation is usually required in the black patient. Autologous grafts are strongly preferred. When less than 2 mm of dorsal augmentation is required, septal cartilage and/or auricular cartilage dorsal onlay grafts can be used.[38] When more than 2 mm of dorsal augmentation is required, an anatomically contoured rib cartilage graft or a diced cartilage fascia technique should be used.

AlloDerm or temporal fascia alone is used for camouflage, not for augmentation because the AlloDerm will resorb over approximately 1 year. However, temporal fascia may be particularly useful for improving minor contour irregularities and for overall camouflaging.

A graduated approach to dorsal augmentation is used, progressing from septal/ear cartilage onlay grafts for minimal to moderate augmentation (less than 2 mm) to costal cartilage or diced cartilage fascia grafts for significant dorsal augmentation (more than 2 mm). AlloDerm or fascia alone are used to correct contour irregularities, not for augmentation.

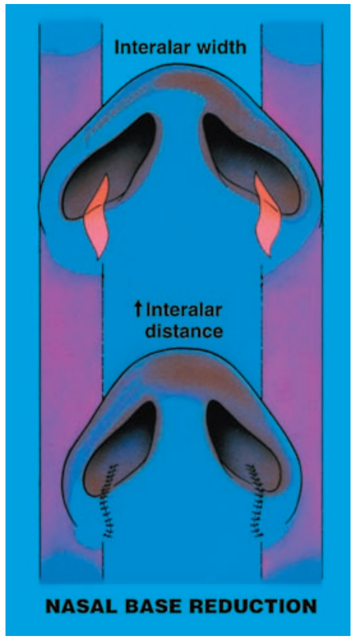
The skin is redraped after a final inspection of the nasal framework, the external appearance is evaluated, and all incisions are closed. The infracartilaginous incisions are closed with 5-0 chromic gut, and the transcolumellar incisions are closed meticulously with 6-0 nylon in an interrupted fashion.



Attention is directed to the basal view for correction of any alar base abnormality (that is, either increased alar flaring, increased nostril size, increased alar base width, or a combination of these).[8] To correct excess flaring of the alar rims (greater than 2 mm outside the medial canthal lines), alar base resection should be performed, maintaining the lower incision within the alar-cheek junction, and curving the incision medially into the nostril to prevent alar notching, as popularized by Sheen and Sheen.[15] Alar base resections should be kept below the alar groove to spare the lateral nasal arteries.

Alar base resection or nostril sill resection is performed after closure of the nasal incisions. After the required resection of the alar base there is always a discrepancy between the lengths of the two wound edges. This is corrected by using a buried 5-0 Vicryl suture followed by closure of the alar base resection with 6-0 nylon using the halving principle. These sutures are removed in 5 to 7 days postoperatively.

Protracted postoperative edema is controlled with prolonged postoperative splinting and postoperative application of silicone gel sheeting and/or prolonged taping.



If there is an increased interalar distance, a Millard-type alar nostril sill resection and advancement are performed in a similar fashion to decrease interalar distance.[39-41]

After alar base surgery is completed and the result inspected from the basal view, assessing for complete symmetry, the nasal splints and dressing are applied. This is a critical portion of the procedure, because black rhinoplasty patients tend to have prolonged postoperative edema. Therefore, if septal work has been performed, bilateral septal splints are placed and sutured into place anteriorly with through-and-through 3-0 nylon sutures. Nasal packing is avoided. An external dressing of Steri-Strips and a Denver nasal splint are placed on the dorsum of the nose for at least 1 week. The importance of keeping the splint on is emphasized. Postoperatively, the patient is instructed to keep ice on the periorbital and nasal areas for 2 days, and to maintain 40 degree elevation of the head to decrease postoperative swelling. Sutures are removed at 5 to 7 days. Silicone sheeting is also used postoperatively in thick-skinned patients for 3 months as tolerated to accelerate the resolution of edema.

A conforming dorsal nasal splint is critical to counteract the increased postoperative edema seen in the black rhinoplasty patient.

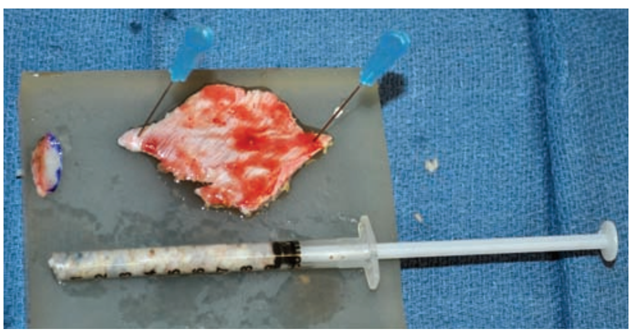
Use of Autologous Tissue

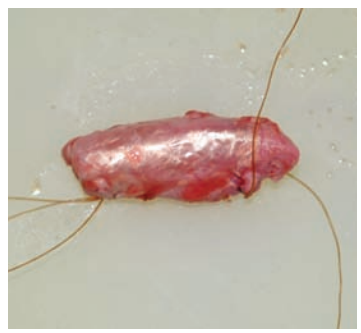
In most cases we prefer to use autologous tissue primarily. For in-depth discussion of harvesting autologous grafts, see Chapter 12.

Preferred Autologous Tissue for Grafting

Septal Cartilage	Ear Cartilage	Rib Cartilage	Temporal Fascia
Tip graft Dorsal onlay graft Columellar strut graft Spreader graft Lateral crural strut graft	Lateral crural cartilage Dorsal onlay graft Tip graft	Dorsal onlay graft Columellar strut graft Tip graft Spreader graft Lateral crural strut graft	Dorsal camouflage graft Diced cartilage fascia graft

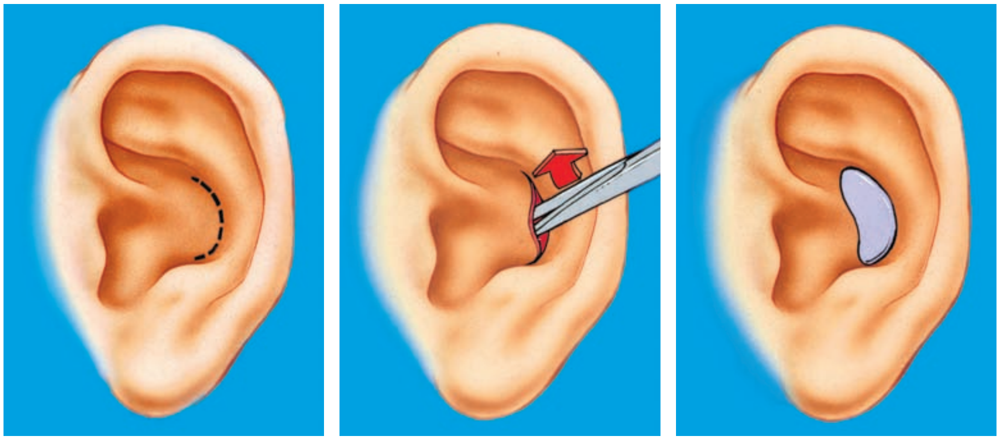
Septal Cartilage





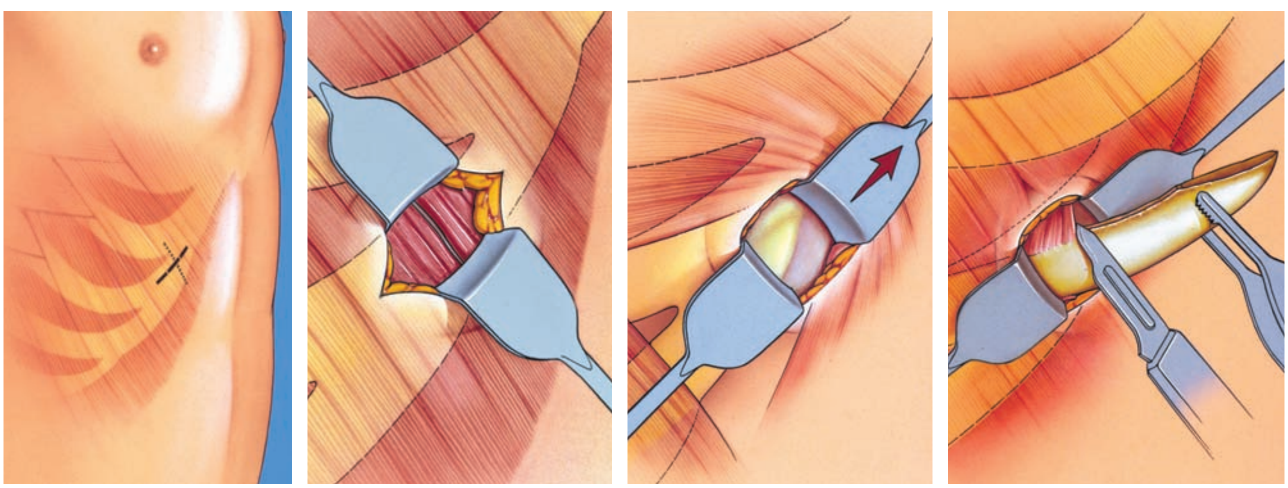
Autologous septal cartilage is preferred for the majority of grafts. Septal cartilage is the material of choice because it provides rigid support that does not have the convolutions found in auricular cartilage. In our hands it has proved excellent for dorsal onlay, columellar strut, lateral crural strut, spreader, and tip grafts. Both septal and ear cartilage can also be diced and wrapped in fascia to augment the dorsum. Diced cartilage wrapped in temporal fascia has become an increasingly popular technique with overall favorable reports in the literature.[42,43]

Ear Cartilage



The ear can provide a large amount of material for cartilage reconstruction and can be harvested from either anterior or posterior approaches. Given its flaccidity and convolutions, ear cartilage is best used when these characteristics are desired, especially when reconstructing the lower lateral cartilages. Ear is not a preferred option for dorsal augmentation or when straight segments are required.

Rib Cartilage



Rib cartilage is excellent when support is a major consideration. Access is obtained through a small incision over the anterior portion of the ninth rib, and the required cartilage is removed.

The key element in rib grafts is to have a straight piece of cartilage to begin with; postoperative warping of the graft can then be avoided in many cases. This cartilage is ideal for a columellar strut graft, and it can be fashioned for use in dorsal augmentation.

If a large amount of cartilage is needed, the incision should be made over the junction of the seventh and eighth ribs where a large block of rib cartilage can be harvested, especially when needed for dorsal augmentation. The principles of carving balanced cross-sections established by Gibson and Davis[44] must be respected in that the cartilage must be carved so that equal amounts are removed from both sides to prevent warping or bending.

End slices of rib cartilage have a tendency to curl and can be used for lower lateral cartilage replacement or selective onlay grafts. Rib cartilage can have a tendency to warp and dicing of rib or other cartilage with onlay perichondial tissue or wrapping in temporal fascia can also be used.[42,43]

Use of the ninth rib cartilage, which is relatively straight, minimizes the incidence of postoperative graft warping. Alternatively, diced cartilage fascia graft can be used.

Other Grafts and Alloplastic Material

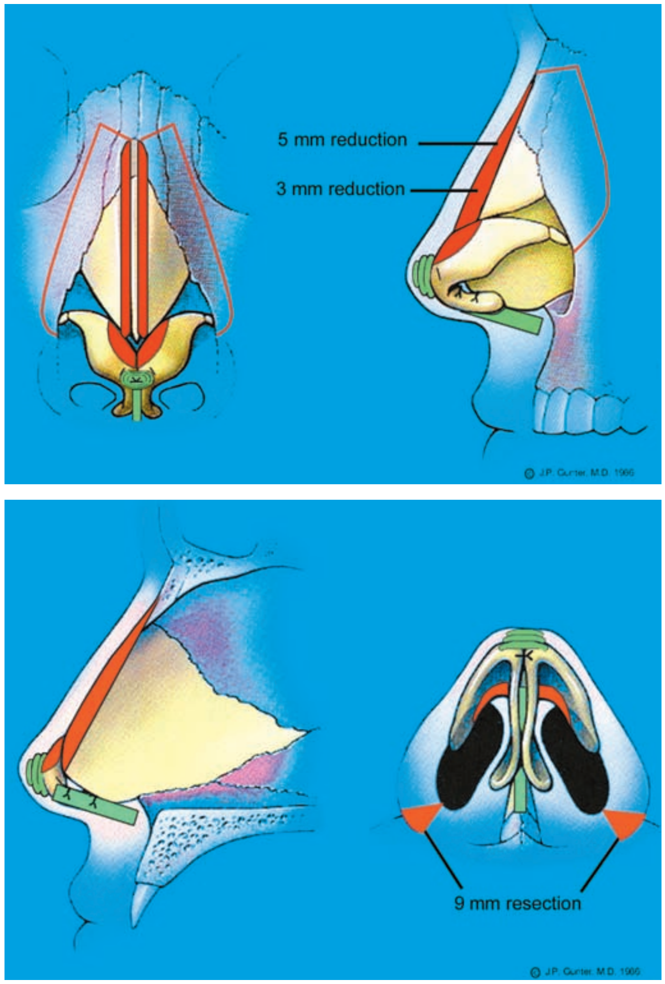
Since we prefer primarily autologous material for long-term safety and to minimize extrusion, we do not advocate the use of silicone, Gore-Tex, or other alloplastic materials in the nose. Dorsal augmentation with a silicone implant may be preferred by the patient. However, the L-shaped implant should be avoided, given the higher risk of exposure and infection through the columella. Silicone dorsal implants require suture stabilization to avoid mobility and to reduce extrusion rates.

CASE ANALYSES

This patient underwent primary rhinoplasty to correct her dorsal hump and wide, poorly defined nose. The frontal view showed wide bony and alar bases with poor tip definition. On the lateral view, the high dorsal hump was evident, as well as the hanging ala and hidden columella. The basal view confirmed the alar flaring and bulbous appearance of the nasal tip with columellar-lobular disproportion. The intranasal examination showed no abnormality.

The operative goals included the following:

- Reduce the dorsal hump.
- Narrow the bony pyramid.
- Correct alar flaring.
- Refine the tip.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous incisions.
2. Perform component reduction of the dorsum.
3. Perform cephalic trim of the lower lateral cartilages.
4. Stabilize the columellar strut graft with intercrural sutures (5-0 PDS).
5. Use multiple tip-suturing techniques with interdomal and transdomal sutures.
6. Place three onlay tip grafts sutured to the tip with 5-0 PDS.
7. Perform lateral osteotomies (low-to-high).
8. Resect the alar base (9 mm alar base resection).

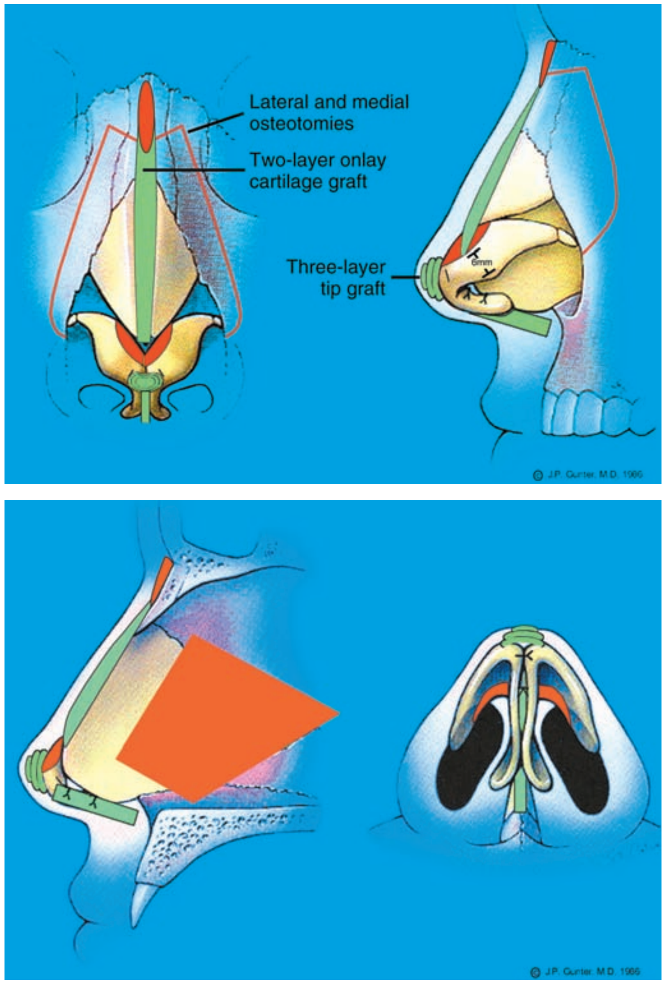
The preoperative analysis and diagnoses were confirmed intraoperatively on direct visualization of the nasal framework via the open approach.

The 2-year postoperative results demonstrate good correction of these deformities.

This primary rhinoplasty patient described her nose as large and unrefined. On the frontal view a wide bony base, wide dorsal aesthetic lines, and a poorly defined bulbous tip were apparent. The lateral view revealed a small dorsal hump and alar-columellar disharmony. The basal view demonstrated the characteristic alar flaring and columellar-lobular disproportion with a bulbous tip. The findings on intranasal examination were normal.

The operative goals included the following:

- Reduce the dorsum.
- Narrow the bony base.
- Correct alar flaring.
- Refine the tip.



Surgical Plan

1. Use an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous incisions.
2. Perform component reduction of the high proximal dorsum.
3. Perform cephalic trim of the lower lateral cartilages preserving a 6 mm alar rim strip.
4. Stabilize the columellar strut graft with 5-0 PDS intercrural suture.
5. Use multiple tip-suturing techniques with interdomal and transdomal sutures.
6. Place three stacked onlay tip grafts sutured to domal cartilages.
7. Perform lateral and medial osteotomies.
8. Resect the alar base, with preservation of nostril size (9 mm resection bilaterally).

The preoperative analysis and diagnoses were confirmed intraoperatively on direct visualization of the nasal framework via the open approach.

The 2-year postoperative results reveal a narrowed, more refined nose with improved tip definition and projection and maintenance of ethnic congruency with nasofacial balance and harmony.

COMPLICATIONS

Several authors have described unsatisfactory results after rhinoplasty, and complications in the black rhinoplasty patient are no different.[45,46] However, several are worth emphasizing. Black rhinoplasty patients may be more prone to certain complications. Matory and Falces[8] plan a secondary procedure routinely, and their patients are counseled accordingly. We do not routinely plan a secondary procedure. In fact, our revision rate in black rhinoplasty patients is similar to that for white patients. However, the patient is certainly told of the possibility, as are all rhinoplasty patients. Certain sequelae are more apt to occur in black rhinoplasty patients.

Revisions or secondary procedures are not required more frequently in the black patient; however, if they are necessary, they should not be performed for at least 12 to 15 months after the initial procedure to allow the edema to resolve.

Protracted Edema

Edema may last up to 12 months because of the thick skin inherent in the black nose, the multiple incisions, and the open approach. However, this can be ameliorated somewhat by meticulous intraoperative hemostasis, prolonged postoperative splinting, and the use of perioperative steroids. Prolonged postoperative use of silicone gel sheeting applied to the nose further accelerates resolution of edema. Mucosal preservation, when possible during alar base resection, has sometimes been advocated to minimize lobule edema.

Excess External Scarring and Keloid Formation

Scarring obviously is of great concern in black patients because of the increased propensity for keloid and hypertrophic scar formation. However, this has not been our experience with the use of meticulous wound closure and early suture removal at 5 to 7 days. We have not seen a keloid scar of the nose in any of our black rhinoplasty patients.

Asymmetry

Asymmetries are noted especially after alar base resections and result from inadequate preoperative planning and operative execution of alar base resection or nostril sill excision. Any degree of asymmetry can be noted intraoperatively and can be easily corrected at that time to minimize or prevent postoperative alar base asymmetry.

Nasal Tip Necrosis

Nasal tip necrosis has not occurred in our experience. However, it is of concern, especially when using the open approach combined with extensive alar base resections, or defatting the nasal skin flap. Alar base resections must not be continued superior to the alar groove, as we have emphasized in our studies delineating the nasal tip blood supply.[47] Defatting should not be performed in the subdermal fat to prevent damage to the subdermal plexus and compromise to the nasal tip blood flow. Onlay tip grafting may apply excessive nasal tip skin tension, which can either compromise blood supply or cause dehiscence or separation of the transcolumellar incision.

Racial Incongruity

Racial incongruity is the most ominous complication in a black rhinoplasty patient. In such a patient, nasal infracture accompanied by excessive alar base resection or nostril sill resection creates a disproportionate narrowing of the dorsum with respect to the lobule, because the alar base resection does not significantly narrow the alar and lobular width. This disproportion can be avoided by employing one of three methods:

1. Adjust the infracture proportionate to the lobule size or avoid nasal pyramid infracture in the majority of black noses.
2. Perform alar base and/or interalar sill reduction at the end of the operative procedure or at a subsequent stage if in doubt about the necessity for this procedure. If there is any doubt about the need for alar base resections, these should not be performed at the primary procedure.
3. Simultaneously use a columellar strut graft and a cartilaginous tip graft so that the increased tip height and definition will lessen the accentuation of the alar width and alar flaring.

Care should be taken to ensure that alar base resections do not compromise the lateral nasal artery blood supply to the nasal tip. The dorsum and lobule should be kept in proportion to avoid racial incongruity. Alar base resections should not be performed at the primary procedure if there is any doubt as to whether or not they are necessary. If necessary, alar base resections can be performed secondarily using local anesthesia.

KEY POINTS

- The black nose is characterized by a wide and low dorsum, decreased tip projection, an ill-defined tip, greater alar flaring and/or interalar distance, diminished nasal length and height, an acute columellar-labial angle, and a low radix.
- Consideration of the evolving black concepts of beauty, the unique anatomic characteristics of the black nose, and specific patient desires as well as fears are essential to surgical success.
- An appreciation of ethnic concepts of beauty and nasofacial harmony and aesthetic balance is a prerequisite for success in treating black rhinoplasty patients.
- By recognizing the classic black nasofacial traits, the rhinoplasty surgeon can work within this context of nasal characteristics by creating improved nasal harmony and avoiding a racial incongruous and artificial result.
- Narrowing the interalar distance or correcting alar flaring can improve nasal appearance without disturbing the ethnic character of the nose. It is important to preserve the natural C-shaped curvature to the lateral alae as it joins the cheek.
- The skin and subcutaneous tissues of black patients are often quite thick and can be inelastic.
- The alar cartilages are not as typically weak and underdeveloped as once thought.
- The alar bases may exhibit increased interalar distance, alar flaring, or both. When both are present, as often is the case, it is important to be prudent in the degree of correction as an overresected alar base is one of the tell-tale signs of poorly performed black rhinoplasty. Alar base resections should be performed at the end of the procedure and not at the initial procedure if there is any doubt regarding their necessity.
- The dorsum is usually broad and low with a wide bony pyramid and splayed and shortened ascending processes of the maxillae. Dorsal augmentation with or without osteotomies is usually warranted.
- Accurate preoperative analysis and diagnosis are essential to formulating a realistic surgical plan. Consent for possible distant graft sites (ear, rib, temporal fascia) should be obtained. The patient's aesthetic aims must be clearly verbalized and documented. An accurate internal and external nasal examination is

essential. An individualized, organized, and realistic operative plan can then be formulated.

- The open approach is advocated for accurate intraoperative anatomic diagnosis under direct binocular vision with precise correction of the deformity. It permits more options in the modification of the native tissues, allowing for precise application of suturing techniques and better use of cartilage grafts, specifically midcolumellar struts and tip grafts to increase tip projection and dorsal onlay grafts to enhance the dorsal profile in the black patient.
- The desired tip projection dictates the appropriate dorsal height. Dorsal augmentation should be performed after septal graft harvest and before setting the final tip projection.
- The use of autologous cartilage grafts is advocated, when such grafts are possible; the use of alloplastic materials is not preferred.
- The septum is ideally approached from the anterior septal angle through the open approach by separating the upper lateral cartilages from the septum in a component fashion.
- The surgeon should use a graduated approach to increasing tip projection with comprehensive suture tip-shaping techniques and cartilage grafting (for shape and support) as dictated by preoperative nasal analysis and continual intraoperative observation of dynamic structural interactions.
- The columellar strut graft is the foundation for tip complex stability and enhanced tip projection.
- A graduated approach to dorsal augmentation is used, progressing from septal/ear cartilage onlay grafts for minimal to moderate augmentation (less than 2 mm) to costal cartilage or diced cartilage fascia grafts for significant dorsal augmentation (more than 2 mm). AlloDerm or fascia alone are used to correct contour irregularities, not for augmentation.
- Protracted postoperative edema is controlled with prolonged postoperative splinting and postoperative application of silicone gel sheeting and/or prolonged taping.
- A conforming dorsal nasal splint is critical to counteract the increased postoperative edema seen in the black rhinoplasty patient.
- Use of the ninth rib cartilage, which is relatively straight, minimizes the incidence of postoperative graft warping. Alternatively, diced cartilage fascia graft can be used.
- Revisions or secondary procedures are not required more frequently in the black patient; however, if they are necessary, they should not be performed for at least 12 to 15 months after the initial procedure to allow the edema to resolve.
- Care should be taken to ensure that alar base resections do not compromise the lateral nasal artery blood supply to the nasal tip. The dorsum and lobule should be kept in proportion to avoid racial incongruity. Alar base resections should not be performed at the primary procedure if there is any doubt as to whether or not they are necessary. If necessary, alar base resections can be performed secondarily using local anesthesia.

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The Hispanic Nose

Rollin K. Daniel

During the past decade, Hispanics have become the largest ethnic minority in the United States. By 2050, it is predicted that Hispanics will exceed whites as the biggest ethnic group in an increasingly multicultural America.[1] Currently, the majority of plastic surgeons in the United States have either little experience with Hispanic rhinoplasty or an unfavorable view of its surgical outcome because of a misconception that all Hispanic noses are a variation of the mestizo nose. This chapter will review the methods of analysis and surgical approaches that I use in performing Hispanic rhinoplasty.

BACKGROUND

Any English-language discussion of Hispanic rhinoplasty must begin with the publications of Fernando Ortiz-Monasterio and his classic writings on the mestizo nose.[2-6] He considered the following five characteristics of mestizo noses to be primary factors that differentiate them from white noses[6]:

1. A thick, sebaceous soft tissue envelope
2. A relatively small osteocartilaginous vault
3. Minimal tip support caused by both a short medial crus and a weak caudal septum
4. A short, hidden columella
5. A broad alar base with round nostrils

The operation he advocated is primarily an augmentation rhinoplasty performed through a closed approach with the following components:

- An intracartilaginous incision, followed by excision of excess cephalic alar cartilage and overlying subcutaneous fat
- Minimal rasp reduction of the bony dorsum and sharp resection of the cartilaginous dorsum
- Dorsal augmentation with a full length dorsal graft of septal cartilage
- A major columellar strut graft designed to open the columellar-labial angle and increase tip support
- A triangular tip graft inserted in the infratip lobule to gain projection and tip definition
- Nostril sill excisions to reduce alar flare with avoidance of alar wedge resections

Sanchez[7] reported on the *Chata* nose, which reflects the unique blending of multiple racial groups that has occurred over time in the Caribbean. This nose is characterized by a very broad, flat lower third with the following hallmarks: a short columella, transverse nostrils, thick skin, and flaring alae. Many characteristics of the black nose are integrated with the mestizo nose, which reflects the socioeconomic history of the Caribbean. The surgical techniques described for treating these noses consisted of various bone grafts or silicone implants for the dorsum, combined with aggressive skin excision in the alar base and nostril sill.

Milgrim et al[8] reported an interesting anthropometric analysis of 97 female Latina noses, including complete nasal photographic analysis and calculation of nasal indices. He classified the subjects into three geographic areas: the Caribbean, Central America, and South America. This extensive analytic paper included these observations: (1) Caribbean Latinos are the most diverse of the subgroups, with a nose resembling the anthropometric norms of the black nose, (2) Central and South American subjects more closely conform to white norms, and (3) the entire Latino group would be categorized as *mesorrhine.* Surgical techniques were discussed, but none was illustrated, nor were there any case studies.

CLASSIFICATION OF NASAL TYPES

In 2002 I published an analysis of 25 consecutive Hispanic rhinoplasties, with emphasis on the Mexican-American nose.[9] The patients' national origins were Caribbean (2), Central American (2), South American (3), and Mexican-American (18). Their distribution was consistent with the diversity of the Hispanic population in Southern California. An initial attempt to divide the patients based on geographic origin using Milgrim's classification[8] of Caribbean, Central American, and South American was not beneficial. For example, a broad range of nasal deformities was readily apparent in Mexican-American patients, ranging from the high bridged Castilian nose to the flat, underprojecting mestizo nose. After reviewing preoperative photographs, we identified three distinct types of nasal deformities, irrespective of national origin.

Hispanic Nasal Types

- Type I consists of a profile with normal radix height/high bridge/normal tip projection, and is often referred to as a Castilian nose (8 of 25; 32%).
- Type II consists of low radix height/near-normal bridge/dependent tip (12 of 25; 48%). It is a new designation and one extremely important to the diagnosis, because minimal dorsal reduction can lead to major secondary problems.
- Type III consists of a broad base/thick skin/wide tip (5 of 25; 20%), with its worst expression in the mestizo nose.
- It should be noted that there is a potential type IV nose, similar to the Chata nose, with predominant black features, not represented in this classification. This type would be present on the East Coast of the United States because of a large number of Hispanics from the Caribbean who reside there.

This wide diversity of anatomic deformities in the Hispanic population is in significant contrast to the more homogeneous deformities present in other ethnic noses.

For simplicity of classification, the four types of Hispanic noses are most easily remembered when associated with more familiar terminology: type I (Castilian), type II (Mexican-American), type III (mestizo), and type IV (Creole).

The Three Most Common Types of Hispanic Noses

Type I (Castilian) is characterized by a high arched osteocartilaginous vault and a tip with near normal projection whose correction can be achieved with a functional reduction rhinoplasty.

Type II (Mexican-American) is characterized by a low radix/upper dorsum and an underprojecting tip, which creates the illusion of a major dorsal hump. Surgical correction requires a finesse rhinoplasty including radix/dorsal grafts and increased tip projection with minimal dorsal reduction.

Type III (mestizo) is characterized by a dorsal/base disproportion resulting from a heavy, wide base with minimal definition, and underprojection of the tip further complicated by a thick skin envelope.

It is essential to use a columellar strut graft and tip graft and to reduce alar flaring through a balanced rhinoplasty.

OPERATIVE TECHNIQUES

Given the wide diversity of presenting deformities, a broad range of surgical techniques is required when treating the Hispanic nose.

A standard operation will be described for each type of nose; however, the surgeon must be prepared to modify it appropriately for the individual patient.

Type I (Castilian)

Given the prominent osteocartilaginous vault and near normal tip projection in type I noses, the basic goal in these cases is to perform a functional reduction rhinoplasty. This procedure will give the patient the smaller nose he or she desires, and retain or improve respiratory function. The primary components of the operative procedure are as follows:

1. The radix is never grafted—a distinct difference in treatment from type II and III noses. The radix is either left alone or reduced to create a distinct notch.

2. Dorsal reduction is performed in all cases. Again, this is a distinct difference from treatment of type II and III noses. The amount of reduction is quite significant and ranges from 2 to 3 mm in the bony vault and from 2 to 5 mm in the cartilaginous vault. In virtually all cases, the caudal septum is resected, either in its upper half for rotation, or full length to shorten and rotate the nose. Many of these noses are wide and require narrowing. Combined low-to-low and transverse osteotomies are performed to achieve complete mobilization.
3. Given the near normal projection and excess volume of the tip, a closed approach is most often used. A simple intracartilaginous resection of the cephalic lateral crura with their overlying subcutaneous tissue is performed to achieve volume reduction as well as tip rotation and greater tip definition. If required, minor increases in tip projection can be achieved with a columella-septal projection suture. However, when tip definition is markedly deficient, an open tip suture technique is used.[10]
4. The amount of nasal base reduction required ranges from none to nostril sill resection (reduction of nostril show) to alar wedge resection (reduction of alar flare) to combined nostril sill/alar wedge resections (maximum narrowing).[11] Suturing the alar cartilages to increase columellar length and achieve a more refined tip is shown in the following intraoperative views.

Type II (Mexican-American)

Type II cases are extremely challenging from an analytic viewpoint and require maximum surgical finesse. The critical factor is the presence of the normal dorsal height over the cartilaginous vault with decreased projection in both the adjacent radix area and tip. The basic goal in these cases is to perform a finesse rhinoplasty using the following steps:

1. Grafting of either the radix or the radix/upper half of the dorsum is required. In most cases, the graft must extend over the deficient bony vault, which is in marked contrast to either the type I or III nose. After producing an unacceptable rate of visible radix grafts using cartilage, deep

temporal fascia is now used routinely in the radix area.[11] However, larger grafts that must fill the radix and upper half of the dorsum risk visualization at the graft's transition with the normal dorsum under the ultrathin skin of the rhinion. Currently, I prefer a beanbag graft of diced cartilage wrapped in fascia.[12]

2. Although the dorsum is not lowered in most cases, smoothing of any prominence may be necessary. In addition, the use of spreader grafts to correct preexisting internal valve collapse or significant dorsal asymmetries must be considered. In most cases osteotomies are not required, nor is the caudal septum resected. In certain cases, slight narrowing can be achieved using low-to-high osteotomies without creating an open roof.
3. Achieving sufficient tip projection and definition can be challenging, especially with variations in skin thickness. The open approach with insertion of an 18 by 3 mm straight columellar strut graft followed by tip suturing is highly effective. Performing an add-on tip graft if suturing is insufficient is always an option.
4. Base modification varies enormously from nothing to nostril sill excisions to alar wedge resections to combined nostril sill/alar base resections.

Type III (Mestizo) and Type IV (Creole)

The fundamental principle in treating these cases is to correct the dorsal/base disproportion by maximally changing the base first and then augmenting the dorsum only if required. In most cases, the distal third of the nose is quite large and ensheathed in thick skin. An open approach is favored because it allows correction of virtually all anatomic deformities. The primary components of this balanced rhinoplasty are as follows:

1. The skin envelope is managed by resecting the subcutaneous tissue and wide skin undermining, which allows the skin to redrape laterally. The initial incisions are paired infracartilaginous incisions, followed by a subcutaneous dissection over the entire lobule. Then the transcolumellar incision is made and the skin retracted upward, allowing direct excision of the thick subcutaneous tissues that remain attached to the alar cartilages. The retracted skin envelope is not directly defatted.
2. If required, the dorsum is smoothed and the radix area grafted. Septal cartilage is harvested, and conchal cartilage if necessary. The harvested septal cartilage is divided into a columellar strut graft (25 by 8 mm), tip graft (18 by 8 mm), alar contour grafts (8 by 3 mm), and rarely a dorsal graft (34 by 6 mm).
3. Cephalic alar cartilage is resected leaving 5 mm wide symmetrical alar rim strips. The rigid columellar strut graft is placed between the alar car-

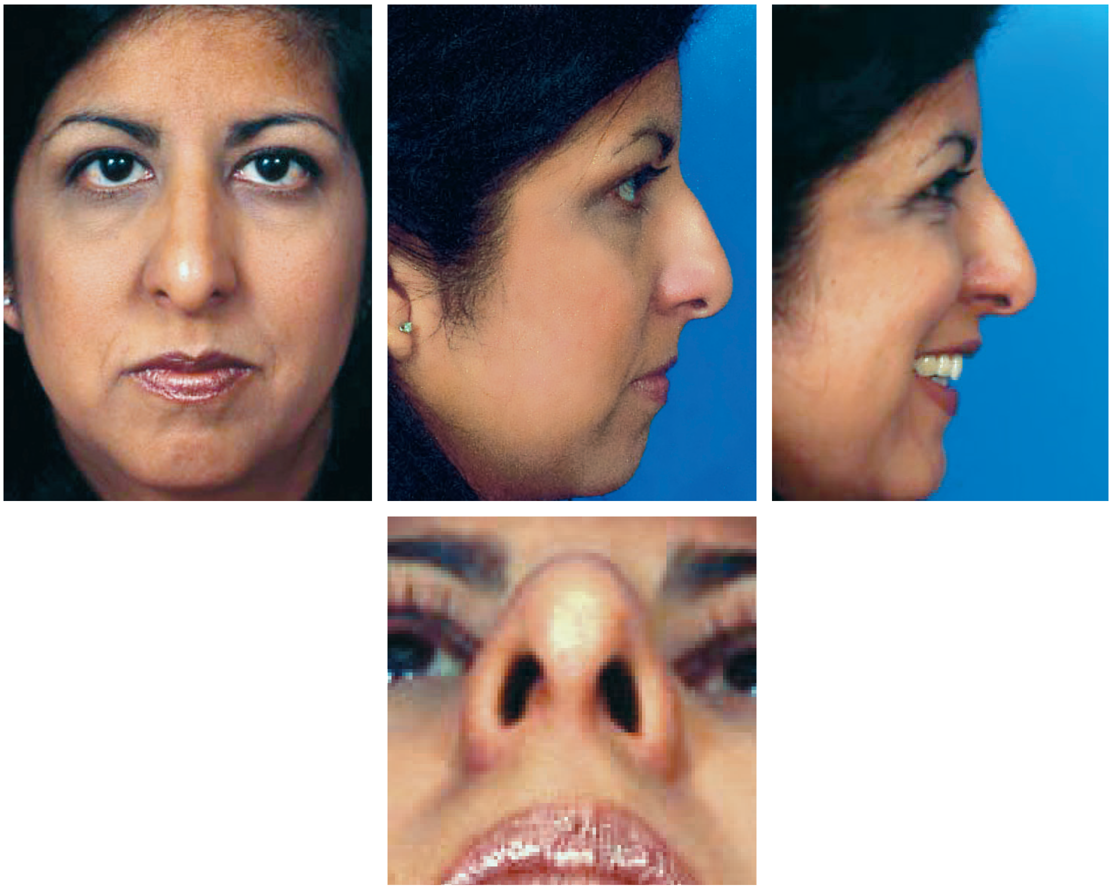
tilages, which are then advanced upward and fixed at two points with 5-0 PDS. The strut is shaped like a bowie knife and is intended to push the columellar-labial segment downward.[4] The advancement of the medial and middle crura on the columellar strut graft effectively lengthens the columella.

4. The tip graft is made from rigid septal cartilage and is kept quite long (18 mm) with a very defined upper border that is 6 to 9 mm wide. The graft is inserted in a projected position above the domes and sutured to the crura at 4 to 6 points with 5-0 PDS. A cap graft is inserted behind the projecting portion of the graft acting as an effective backstop to prevent long term flattening of the graft.[13] The skin is redraped multiple times to assess the projection and definition obtained.
5. After closure of the incisions, base modification is performed. In most cases, a combined nostril sill/alar wedge resection is performed, which effectively reduces both nostril size and alar flaring. Although quite significant in their dimensions, a 2 to 3 mm nostril sill resection and a 3 to 6 mm alar wedge resection are smaller than those performed in many black patients. In severe cases, the nostril sill component is deepithelialized and used as a modified alar cinch.[14] Alar contour grafts are often required to avoid notching of the alar rim.[11]
6. Internal and external splints are applied. The cast and all sutures are removed at 6 days. Two important points are the absence of any osteotomies as well as any significant dorsal work, either reduction or augmentation.
7. The type IV Creole nose is often quite similar to the typical black nose. The three most common variations in correction would be significant dorsal augmentation using diced cartilage in fascia grafts,[12] major columellar support using either septal cartilage or rib,[15] and very aggressive narrowing of the alar bases.

In summary, the defining characteristic of the type I nose is the high dorsum requiring a functional reduction rhinoplasty. The type II nose is defined by a virtually normal dorsal height, but with adjacent decreased radix and tip projection. Treatment necessitates a finesse rhinoplasty with radix/dorsal grafts and increased tip projection. Type III is characterized by a large base whose reduction usually involves soft tissue excision, a columellar strut graft, tip graft, and alar base excision. Radix augmentation and minimal dorsal reduction complete a balanced rhinoplasty approach. This classification has been beneficial in analyzing and formulating treatment plans for Hispanic patients.

CASE ANALYSES

Type I (Castilian)

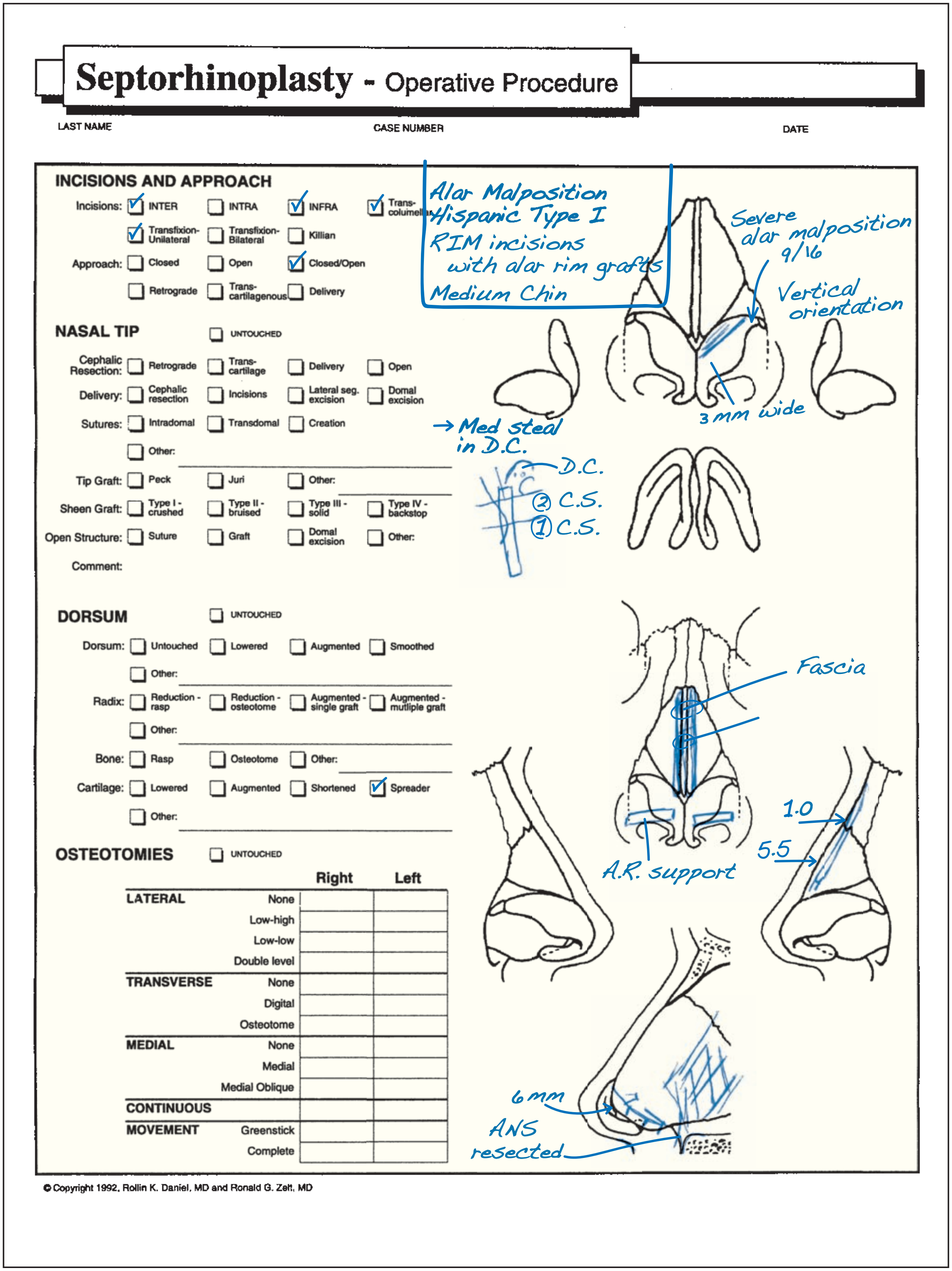


This 35-year-old Hispanic woman requested rhinoplasty because she did not like her nasal profile, especially its "beakiness." Clinical analysis revealed three major problems: (1) a classic type I Castilian nose, (2) a significant hanging columella on the frontal view, and (3) an ill defined tip.

This case was extremely difficult because of the major imbalance between the patient's dorsal convexity and the hypoplastic tip. The goals were to define her tip and eliminate the hanging columella. A closed/open approach was selected. The initial examination confirmed severe alar malposition, with the caudal edge of alar cartilages 9 mm back from the retracted alar rim. (A medium chin implant was inserted at the beginning of the surgery.)

Surgical Plan

1. Use an open approach with true alar rim marginal incisions rather than infracartilaginous incisions for future insertion of alar rim support grafts.
2. Perform dorsal reduction: bony vault (1 mm, rasp), cartilage vault (5.5 mm, knife).
3. Expose the septum, followed by a 6 mm contoured resection of the caudal septum and excision of the anterior nasal spine.
4. Harvest septum, with division into columellar strut graft, alar rim grafts, and spreader grafts.
5. Perform low-to-high osteotomies.
6. Use an open approach with virtually no resection of the cephalic lateral crura.
7. Insert bilateral spreader grafts.
8. Insert a columellar strut graft with two medial crural–columellar strut sutures to lengthen the columella.
9. Refine the tip with domal creation sutures.
10. Insert alar rim support grafts to lower the alar rims.
11. Close all incisions.



Septorhinoplasty - Operative Procedure

LAST NAME | CASE NUMBER | DATE

INCISIONS AND APPROACH

Incisions: ☑ INTER ☐ INTRA ☑ INFRA ☑ Trans-columella
☑ Transfixion-Unilateral ☐ Transfixion-Bilateral ☐ Killian

Approach: ☐ Closed ☐ Open ☑ Closed/Open
☐ Retrograde ☐ Trans-cartilagenous ☐ Delivery

NASAL TIP ☐ UNTOUCHED

Cephalic Resection: ☐ Retrograde ☐ Trans-cartilage ☐ Delivery ☐ Open

Delivery: ☐ Cephalic resection ☐ Incisions ☐ Lateral seg. excision ☐ Domal excision

Sutures: ☐ Intradomal ☐ Transdomal ☐ Creation
☐ Other:

Tip Graft: ☐ Peck ☐ Juri ☐ Other:

Sheen Graft: ☐ Type I - crushed ☐ Type II - bruised ☐ Type III - solid ☐ Type IV - backstop

Open Structure: ☐ Suture ☐ Graft ☐ Domal excision ☐ Other:

Comment:

DORSUM ☐ UNTOUCHED

Dorsum: ☐ Untouched ☐ Lowered ☐ Augmented ☐ Smoothed
☐ Other:

Radix: ☐ Reduction - rasp ☐ Reduction - osteotome ☐ Augmented - single graft ☐ Augmented - mutliple graft
☐ Other:

Bone: ☐ Rasp ☐ Osteotome ☐ Other:

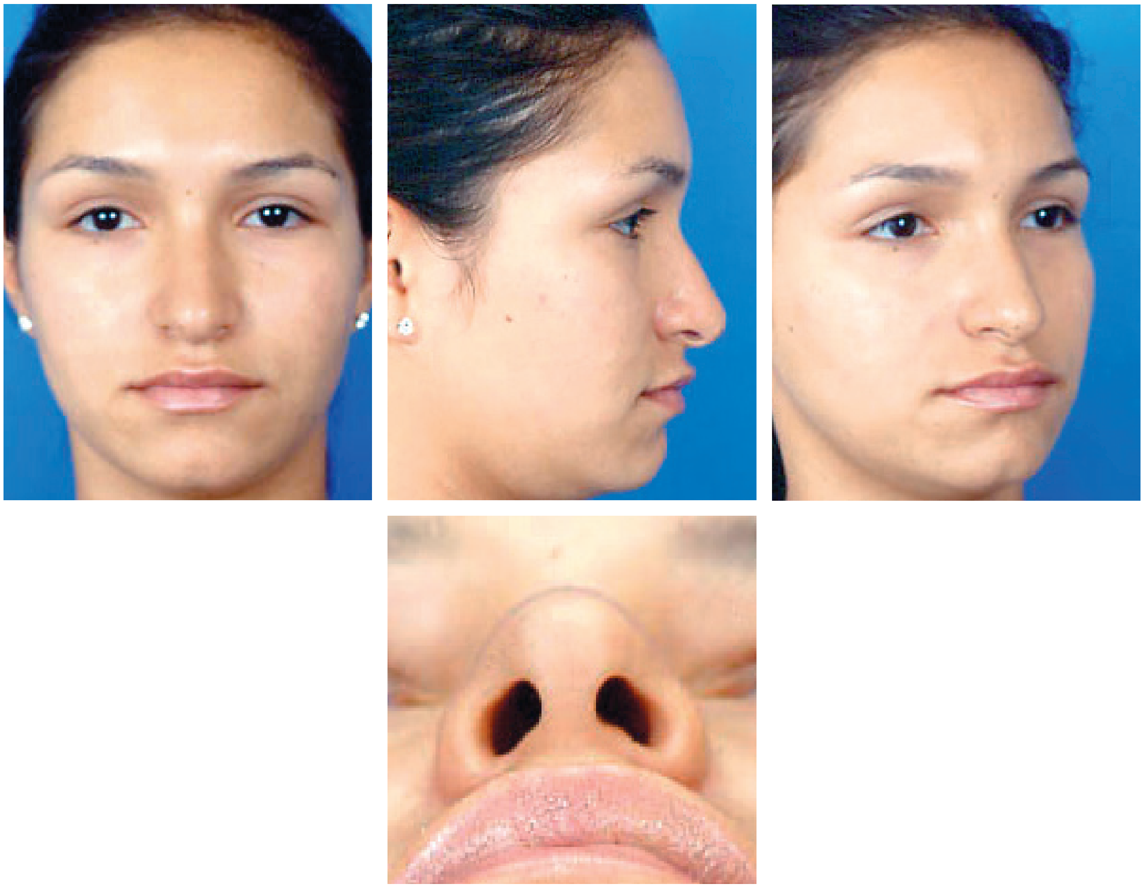
Cartilage: ☐ Lowered ☐ Augmented ☐ Shortened ☑ Spreader
☐ Other:

OSTEOTOMIES ☐ UNTOUCHED

		Right	Left
LATERAL	None		
	Low-high		
	Low-low		
	Double level		
TRANSVERSE	None		
	Digital		
	Osteotome		
MEDIAL	None		
	Medial		
	Medial Oblique		
CONTINUOUS			
MOVEMENT	Greenstick		
	Complete		

The patient is shown 1 year postoperatively. Her nasal deformity was corrected after a functional reduction rhinoplasty with emphasis on dorsal reduction and increased tip definition with open tip suturing. The anterior view shows a well defined tip; the eye is no longer drawn to the columellar breakpoint. The preexisting alar rim retraction and the severity of the malpositioned infantile alae were the indications for the alar rim support grafts.

Type II (Mexican-American)



This 17-year-old Hispanic student was referred for a rhinoplasty by another plastic surgeon. Her primary concern was her nose on profile view; her nose tip plunged downward when she smiled. It was explained to her that the height of her cartilaginous dorsum was essentially normal, but the radix was low and the tip projection was marginally acceptable. In addition, the nose was wide both dorsally and laterally.

The challenge in this case was to create a smaller, shorter nose without an over-operated look, hence without dorsal reduction. The goals were to shorten the nose in absolute terms and make the hump disappear by elevating the radix area and projecting the tip.

Surgical Plan

1. Use an open approach through infracartilaginous and transcolumellar incisions.
2. Expose the septum and resect 6 mm of the caudal septum.
3. Harvest septal cartilage and fabricate a straight columellar strut graft.
4. Excise a minimal amount of alar cartilage (scroll area only).
5. Narrow (rather than lower) the dorsum using parallel cuts 5 mm apart in the dorsum and then perform low-to-low osteotomies; mobilize the bones with digital compression.
6. Insert a columellar strut graft followed by a six-suture tip technique: medial crural–columellar strut (two), domal creation, interdomal, domal equalization, and columellar-septal projection.
7. Insert a major radix graft consisting of diced cartilage wrapped in fascia (0.5 cc of cartilage).
8. Close all incisions with 2.5 mm nostril sill excisions.

Septorhinoplasty - Operative Procedure

LAST NAME CASE NUMBER DATE

Hispanic Type II
DC-F.5
Very Long Nose

INCISIONS AND APPROACH

Incisions: ☐ INTER ☐ INTRA ☑ INFRA ☑ Trans-columellar
☑ Transfixion-Unilateral ☐ Transfixion-Bilateral ☐ Killian

Approach: ☐ Closed ☑ Open ☐ Closed/Open
☐ Retrograde ☐ Trans-cartilagenous ☐ Delivery

NASAL TIP

☐ UNTOUCHED

Cephalic Resection: ☐ Retrograde ☐ Trans-cartilage ☐ Delivery ☐ Open

Delivery: ☐ Cephalic resection ☐ Incisions ☐ Lateral seg. excision ☐ Domal excision

Sutures: ☐ Intradomal ☐ Transdomal ☐ Creation
☐ Other: sutures x 5/6

Tip Graft: ☐ Peck ☐ Juri ☐ Other:

Sheen Graft: ☐ Type I - crushed ☐ Type II - bruised ☐ Type III - solid ☐ Type IV - backstop

Open Structure: ☐ Suture ☐ Graft ☐ Domal excision ☐ Other:

Comment:

DORSUM

☐ UNTOUCHED

Dorsum: ☐ Untouched ☐ Lowered ☐ Augmented ☐ Smoothed
☑ Other: Modified (Narrowed—parallel osteotomies)

Radix: ☐ Reduction - rasp ☐ Reduction - osteotome ☐ Augmented - single graft ☐ Augmented - mutliple graft
☐ Other: No reduction —

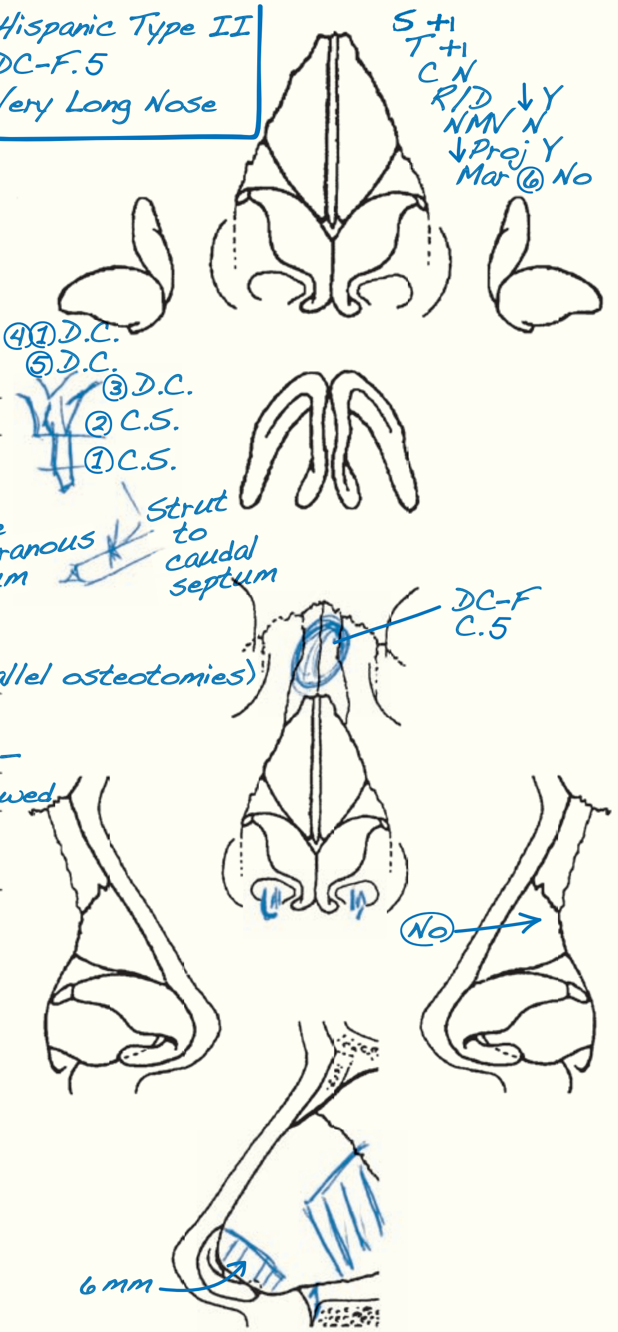
Bone: ☐ Rasp ☐ Osteotome ☐ Other: Only narrowed

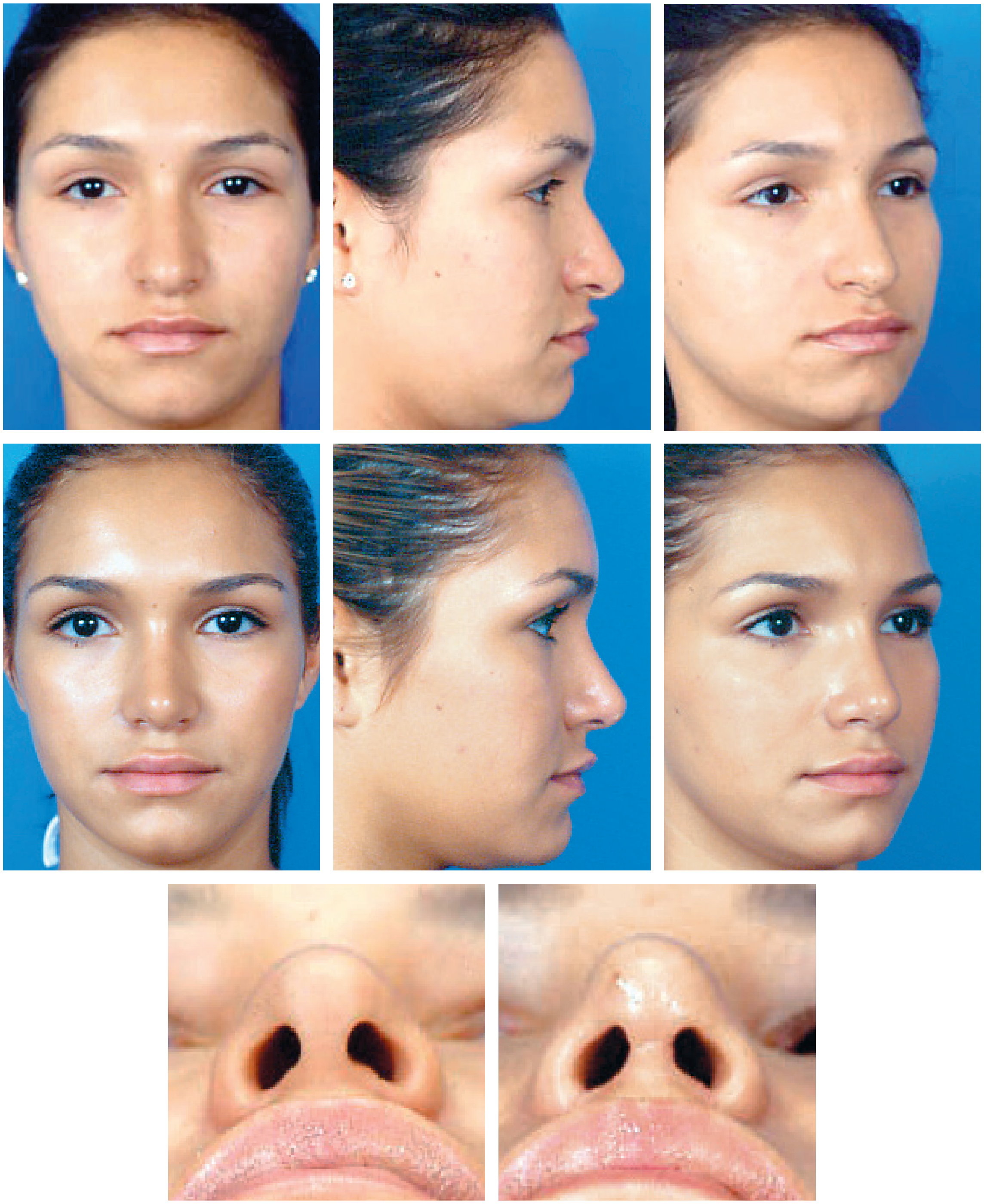
Cartilage: ☐ Lowered ☐ Augmented ☐ Shortened ☐ Spreader
☐ Other:

OSTEOTOMIES

☐ UNTOUCHED

		Right	Left
LATERAL	None		
	Low-high		
	Low-low	✓	✓
	Double level		
TRANSVERSE	None		
	Digital	✓	✓
	Osteotome		
MEDIAL	None		
	Medial		
	Medial Oblique		
CONTINUOUS			
MOVEMENT	Greenstick		✓
	Complete	✓	





The patient is shown 15 months postoperatively. Her nasal deformity has been improved through the finesse rhinoplasty, which emphasizes a radix graft, minimal dorsal reduction, and a minor increase in tip projection. Narrowing of the dorsum has produced a more refined set of dorsal lines.

Type III (Mestizo)

This 24-year-old Hispanic woman of Cuban background requested a rhinoplasty. She was especially concerned about the tip. I explained that any major change in the tip would be limited by her thick soft tissue envelope and dorsal/base disproportion. The discrepancy between intercanthal width (EN-EN 29) and alar flare (AL-AL 39) was an extreme 10 mm.

A balanced approach was necessary. There was minimal dorsal reduction followed by radix augmentation and increased tip definition/reduction by open structure tip graft. (A small chin implant was inserted at the beginning of the surgery.)

Surgical Plan

1. Perform lobular defatting with infracartilaginous incisions and closed elevation of the tip skin in the subdermal plane.
2. Make a transcolumellar incision to expose the lobule, and defat the soft tissue from the underlying alar cartilages.
3. Perform minimal rasping of the dorsum (bone 0.5 mm, cartilage 1.0 mm).
4. Harvest septum and fascia.
5. Perform low-to-high osteotomies.
6. Fabricate asymmetrical spreader grafts (right 1.0 mm, left 2.5 mm).
7. Place an open structure tip graft with a columellar strut graft, domal sutures, and a shield tip graft.
8. Create a radix graft using fascia.
9. Close all incisions.
10. Perform a combined nostril sill/alar wedge resection (3/3 mm).
11. Use alar contour grafts to minimize alar rim notching.

Septorhinoplasty - Operative Procedure

LAST NAME CASE NUMBER DATE

Hispanic
Maximum Lobule
Balanced App
Creole Type IV
Cuban

INCISIONS AND APPROACH

Incisions: ☐ INTER ☐ INTRA ☑ INFRA ☑ Trans-columellar
☑ Transfixion-Unilateral ☐ Transfixion-Bilateral ☐ Killian

Approach: ☐ Closed ☑ Open ☐ Closed/Open
☐ Retrograde ☐ Trans-cartilagenous ☐ Delivery

NASAL TIP

☐ UNTOUCHED

Cephalic Resection: ☐ Retrograde ☐ Trans-cartilage ☐ Delivery ☐ Open

Delivery: ☐ Cephalic resection ☐ Incisions ☐ Lateral seg. excision ☐ Domal excision

Sutures: ☐ Intradomal ☐ Transdomal ☐ Creation
☐ Other: Open strut

Tip Graft: ☐ Peck ☐ Juri ☐ Other:

Sheen Graft: ☐ Type I - crushed ☐ Type II - bruised ☐ Type III - solid ☐ Type IV - backstop

Open Structure: ☐ Suture ☐ Graft ☐ Domal excision ☐ Other:

Comment:

DORSUM

☐ UNTOUCHED

Dorsum: ☐ Untouched ☑ Lowered ☐ Augmented ☐ Smoothed
☐ Other:

Radix: ☐ Reduction - rasp ☐ Reduction - osteotome ☐ Augmented - single graft ☐ Augmented - mutliple graft
☐ Other:

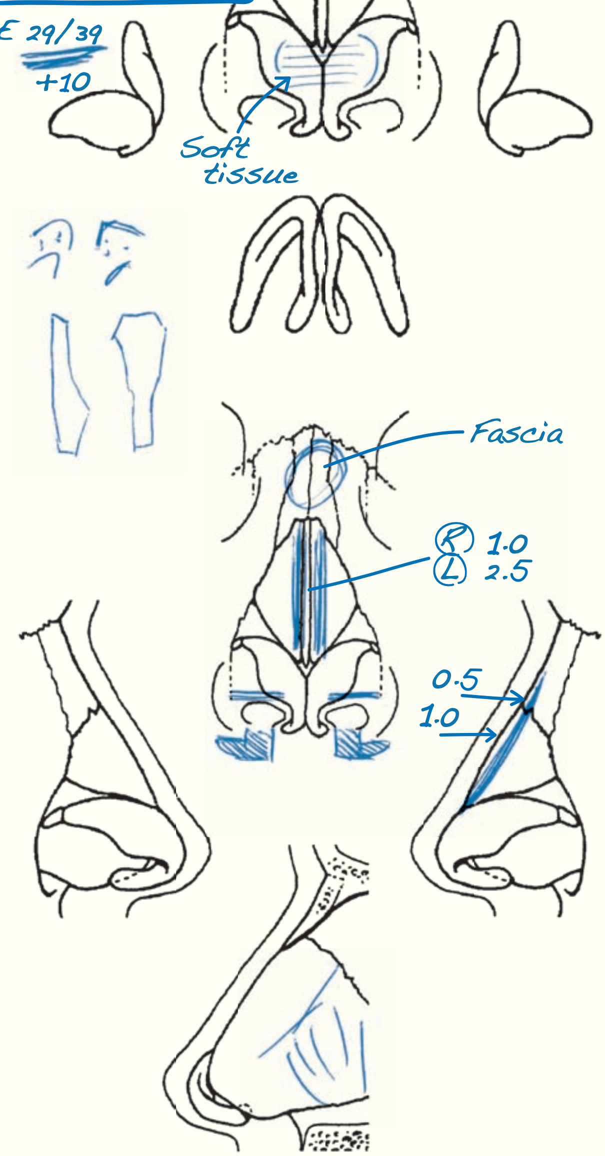
Bone: ☑ Rasp ☐ Osteotome ☐ Other:

Cartilage: ☑ Lowered ☐ Augmented ☐ Shortened ☑ Spreader
☐ Other:

OSTEOTOMIES

☐ UNTOUCHED

		Right	Left
LATERAL	None		
	Low-high	✓	✓
	Low-low		
	Double level		
TRANSVERSE	None		
	Digital	✓	✓
	Osteotome		
MEDIAL	None		
	Medial		
	Medial Oblique		
CONTINUOUS			✓
MOVEMENT	Greenstick	✓	
	Complete		



The patient is shown 1 year postoperatively. Her nasal deformity has been improved significantly; a balanced rhinoplasty has emphasized tip definition through the use of an open structure technique and alar base narrowing. Reduction of her alar base width was achieved using combined nostril sill/alar base excisions, resulting in a 5 mm reduction at 1 year (AL-AL 34). Tip refinement was achieved despite the extremely thick soft tissue envelope.

SELECTED SURGICAL TECHNIQUES

Although few if any of the individual surgical techniques described in this chapter are original, their combination into a suggested surgical operation for each type of Hispanic nose is new.[9] Each of the recommended operations has one or two critical steps that warrant discussion.

Type I

The ultimate goal for type I patients is to achieve a smaller nose by performing a functional reduction operation.

Almost all type I patients present because of the bump on profile and the overall size of the nose. The radix is usually normal, and a straightforward dorsal reduction is performed (a rasp for bony vault, a knife for cartilage vault). In most cases, the tip is adequately projected or even overprojected, permitting a closed approach and simple volume reduction of the tip. Spreader grafts are inserted in virtually all cases after the dorsal reduction. Significant narrowing of the bony vault is achieved with low-to-low and transverse osteotomies, permitting complete mobilization. In many ways, rhinoplasty on these noses is similar to that of a typical rhinoplasty on a white patient's nose.

Type II

The objective for type II patients is to achieve a straight profile with set off of the tip using a finesse approach.

Without question, the radix/upper half of the dorsum defect is extremely challenging in type II patients. Any partial length graft will have a tendency to show through the thin skin at the rhinion where the junction between the graft and the dorsum occurs. Although Sheen and Sheen[16] have been able to achieve success with half length dorsal grafts, few others have. I agree with Ortiz-Monasterio[6] that partial-length grafts do not work well and that full-length grafts are essential. Recently I have expanded my use of diced cartilage grafts; they appear to be ideal for radix/dorsal grafts.[12] The advantage is that diced scraps of available cartilage (concha or septum) can be used rather than the elusive 35 by 5 mm piece of septal cartilage required for a dorsal graft. Unlike Erol,[17] I wrap the diced cartilage

grafts in fascia and have not seen the absorption that occurred when I used the Turkish delight grafts wrapped in Surgicel. The ability to graft the radix/dorsum means that there will be no dorsal reduction. The majority of these noses require neither osteotomies nor caudal septal resection. The open tip suture technique allows the alar cartilages to be repositioned and shaped with minimal resection. The variable is the skin thickness, and simple onlay tip grafts can be added to gain projection and definition should sutures prove inadequate.

Type III

Because many of these cases involve mestizo-type deformities, a comparison of the selected surgical techniques with those of Ortiz-Monasterio and colleagues[2-6] seems appropriate. Although I learned many of them from Ortiz-Monasterio, two major differences are my preference for (1) the open approach rather than the closed approach, and (2) major base reduction, which decreases the frequency of dorsal augmentation. I prefer the open approach for insertion of the columellar strut graft and tip graft for three reasons. First, I can thin the soft tissue envelope maximally and safely by a closed subcutaneous dissection followed by direct excision through the open approach. Second, suture fixation of the grafts allows wide skin redraping laterally in addition to maximum skin contraction. With the closed approach, small pockets for the grafts must be retained, which limits skin undermining and also minimizes contracture around the new tip (that is, rather than creating a structure around which skin contracture can occur, the skin envelope is stretched with closed grafts). Third, the open approach facilitates both placement and fixation of the grafts and does not rely on their subcutaneous placement.

Technically, the base is reduced in three ways: (1) direct excision of the subcutaneous tissue of the lobule, (2) wide skin undermining allowing lobular skin to shift laterally, and (3) major combined nostril sill/alar wedge resections. Conceptually, maximum base reduction combined with grafting of the radix minimizes the need to graft the dorsum. Dorsal grafting is reserved for patients with true dorsal deficiency rather than a pseudodeficiency produced by a large base. In most of his writings, Ortiz-Monasterio[2-6] favored only nostril sill excisions and avoided alar wedge resections to prevent unpredictable scarring. If the alar wedge incision is placed 1 mm above the crease, the scar is usually quite favorable. Although some visibility may be present for 6 to 9 months, none has had to be revised thus far. In contrast, I have seen several Hispanic patients in consultation who were concerned about their alar base scars when the incision destroyed the natural alar crease or excessive resection was performed, severely narrowing the nostril opening.

Presently I continue to perform a significant number of Hispanic rhinoplasties, and the principles described in my first publication have been validated by long-term follow-up.[9]

The most fundamental concept remains the balanced triad of radix grafting, minimal dorsal reduction, and increased tip projection/definition using either tip suture or tip graft techniques.

FUTURE DIRECTIONS

For most American plastic surgeons, Hispanic rhinoplasty ranks third in their number of ethnic rhinoplasties, after Asian and black, depending on geographic region.[18,19] However, the number of Hispanic rhinoplasties will increase dramatically in the coming decade because of the increase in the percentage of the U.S. population that is Hispanic and the greater prosperity of this population. Currently in my practice, Hispanic rhinoplasty exceeds the other two common ethnic rhinoplasties combined, but it does lag behind Middle Eastern cases. The most pleasant surprise in dealing with Hispanic patients has been their happiness with the results. In other ethnic groups, the surgeon often wishes that more could have been achieved—greater tip definition in the Asian nose or an even greater size reduction in the black nose.[18,19] Plastic surgeons will find Hispanic rhinoplasty extremely rewarding for their patients and an area of surgical challenge.

KEY POINTS

- For simplicity of classification, the four types of Hispanic noses are most easily remembered when associated with more familiar terminology: type I (Castilian), type II (Mexican-American), type III (mestizo), type IV (Creole).
- Given the wide diversity of presenting deformities, a broad range of surgical techniques is required when treating the Hispanic nose.
- The ultimate goal for type I patients is to achieve a smaller nose by performing a functional reduction operation.
- The objective for type II patients is to achieve a straight profile with set-off of the tip using a finesse approach.
- The most fundamental concept remains the balanced triad of radix grafting, minimal dorsal reduction, and increased tip projection/definition using either tip suture or tip graft techniques.

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The Middle Eastern Nose

Rod J. Rohrich ▪ Ashkan Ghavami

Rhinoplasty is one of the most challenging and humbling aesthetic operations we perform. The Middle Eastern nose perhaps best exemplifies the inherent difficulties that a rhinoplasty surgeon faces in providing a predictable, long-lasting improvement in nasal appearance and battling postoperative healing forces. The combination of nasal imbalances can be exaggerated, such as a large bony hump and thin skin, which create pitfalls that must be avoided.

In the ethnic nose, it is critical to avoid racial incongruity, which produces an imbalance in facial ethnic features.[1,2] For example, a white-looking nasal contour on a Middle Eastern patient with Fitzpatrick type IV skin, thick/sebaceous alar rim skin, and other ethnic facial traits will create an overoperated facial appearance. Although an accepted standard of beauty may exist, Middle Eastern patients may desire a nose that retains specific ethnic traits, such as a higher dorsum and a less obtuse nasolabial angle.[1-5] This concept is similar to performing rhinoplasty in the male patient, in whom it is imperative that masculine features be preserved.[6] Young females make up a large proportion of the Middle Eastern patient base; thus it becomes important to include the patient's parents (often the mother) in the details of the preoperative analysis, operative plan, and informed consent procedure, and to assess the patient's maturity level. As with any aesthetic procedure, the surgeon should only perform an operation that falls within his or her aesthetic judgment and ethical boundaries. Even if requested by the patient, creating a marked nasofacial ethnic imbalance may not be in the best interest of the patient or the surgeon.

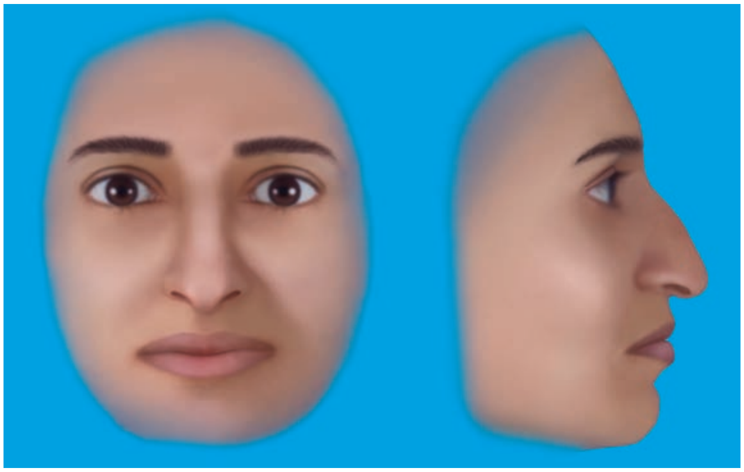
Adapted from Rohrich RJ, Ghavami A. Rhinoplasty for the Middle Eastern nose. Plast Reconstr Surg 123:1343-1354, 2009.

The Middle Eastern nose demonstrates important morphologic features that exist on a gradient between the black nose and the white nose.[1,2,7-19] Some similar nasal features are shared with black, Mediterranean, and Hispanic/mestizo ethnic subgroups; however, significant distinctions must be made to tackle the complex nasal morphology through an individualized, ethnosensitive approach that maximizes predictability and minimizes poor aesthetic outcomes.[1,15-21]

The term *Middle Eastern* commonly refers to people of Arabic, Turkish, North African, and Persian descent. Specific ethnic delineation and geographic distinctions can be further clarified but are beyond the scope of this chapter and are debatable. For example, Iran is known by anthropologists as being part of the Near East rather than part of the Middle East, but Pakistan and India are considered to be Asiatic countries. In a review of Middle Eastern rhinoplasty techniques, Bizrah[7] divided the Middle East population into the Middle Eastern, North African, and Gulf regions. He made a particular distinction as to the aesthetic preferences and social distinctions of specific groups, namely between Gulf (Saudi Arabia, United Arab Emirates, Kuwait, Iran, and Oman) and non-Gulf groups (Syria, Turkey, Lebanon, Turkey, Egypt, and Morocco). Patients from non-Gulf countries may desire more tip projection and less dorsal height than patients from neighboring countries.[7,10]

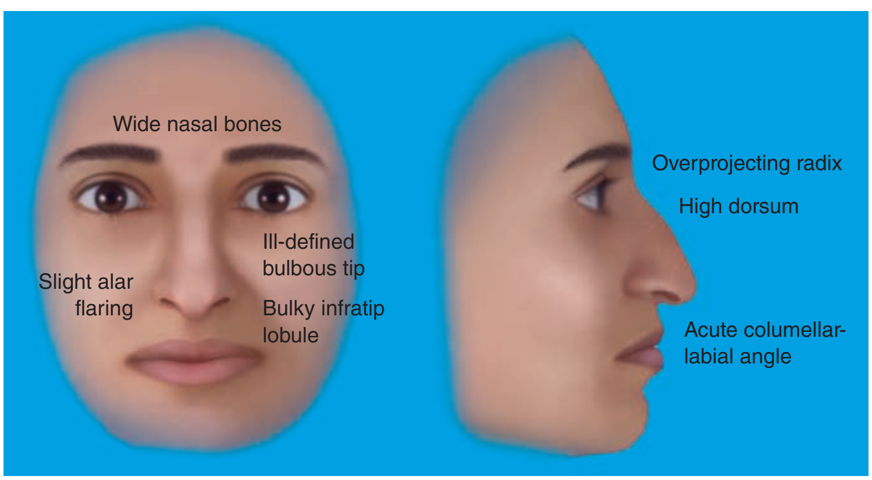
Ancient depictions of kings of the Persian Empire show the classic Middle Eastern nose. Note the dorsal hump, as well as the plunging and ill-defined nasal tip. Sculptures and paintings from early eras accurately portrayed some facial characteristics while exaggerating others, such as the length and aperture of the eyes, and chin prominence (often accentuated by a beard).

Racial incongruity should be avoided by recognizing the nasal characteristics that are common among Middle Eastern patients and understanding the techniques that can help circumvent an overoperated nasofacial appearance.



The Middle Eastern nose seen in both frontal and lateral views is distinct from that of other ethnic groups.[2] The nasal appearance in a Middle Eastern female frequently demonstrates a combination of a high dorsum, a dependent and/or ill-defined nasal tip, and a thick skin/soft tissue envelope.

We will describe the common features of the Middle Eastern nose and the commonly applied surgical approaches. For purposes of this chapter, the term *Middle Eastern* will refer to patients from North African countries (Morocco, Algeria, Libya, and Egypt), Gulf countries (Saudi Arabia, United Arab Emirates, Kuwait, Iran, and Oman), and other regional ethnic groups (Turkey, Lebanon, Syria, Armenia, Afghanistan, Pakistan, and India). In addition, a mixture of nasal morphology will be shown to demonstrate the variability that can exist in this patient population.



It cannot be overemphasized that generalizations must be avoided regarding the nasal characteristics of specific ethnicities.[2] For example, Ofodile and James[22] described the vast anatomic variations of the black nose. However, an individual-

ized yet systematic approach to rhinoplasty in blacks can assist in formulating a systematic operative plan, as described by Rohrich and Muzaffar.[1] Similar to other ethnic subtypes, the Middle Eastern nose often exhibits a varied combination of specific anatomic characteristics as delineated by Rohrich and Ghavami.[2,20,21] Although a subset of patients may have been represented in this study, complex anatomic variations exist. Although many Middle Eastern patients possess a varied combination of the various nasal characteristics, the most common and significant features are listed below for teaching purposes.

Characteristics of the Middle Eastern Nose

Skin can be either thick or thin, and often noncontractile:
- Thick, sebaceous tip and alar skin (fibrofatty soft tissue envelope), especially at the supratip
- Thin skin (usually dorsal) that can reveal significant osseous changes, especially at the rhinion; thin skin in tip/soft triangle facets

Significant dorsal hump: Bony and cartilaginous
Overprojecting radix: Radix shallow as a component of the dorsal hump
Wide bony and middle nasal vaults: Wide "dorsal aesthetic lines"
Nasal deviation: Septal deviation common and often visible externally
Poorly defined bulbous and/or boxy nasal tip
Tip projection:
- Underprojected nasal tip, caudally displaced
- Overprojected with long lateral and medial crura

Droopy nasal tip with very acute nasolabial and columellar-labial angle
Cephalically and vertically malpositioned lateral crura
Hyperdynamic nasal tip with hyperactive depressor septi nasi muscle
Weak and insufficient middle and medial crura
Nostril-tip imbalance
Nostril asymmetries with flaring and/or excess sill

Recognition of thin-skin variations, particularly in the nasal tip, soft triangle, and rhinion, is important, and alterations to osteocartilaginous frame should be conservative, with contour camouflaging when indicated.

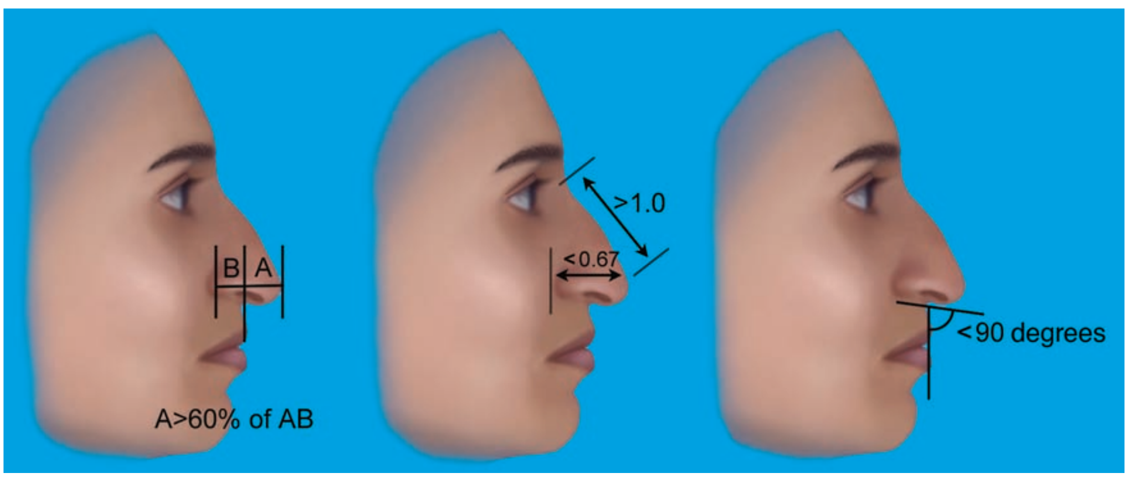
Some North African and Arabian ethnic groups demonstrate nasal features that are similar to black, Asian, and the mestizo/Chata Hispanic noses; however, the Middle Eastern nose seems to lack certain features that often predominate in other ethnic groups.*

*References 1, 2, 7-10, 15, 16, 20, 21, 23.

Infrequently Seen Features of the Middle Eastern Nose

Flat and underprojecting dorsum
Insufficient lateral crura
Inadequate nasal length
Indistinct and/or short nasal bones
Round, transversely oriented nostrils
Obtuse nasolabial angle (and columellar-labial angle)
Excess nostril show on frontal view

The goals of this chapter are to (1) define the clinically significant characteristics of the Middle Eastern nose, (2) describe a systematic open rhinoplasty approach that specifically addresses each nasal attribute, (3) define strategies that may reduce the unpredictability of the postoperative outcome, and (4) define concepts that will help decrease the risk of creating racial incongruity.

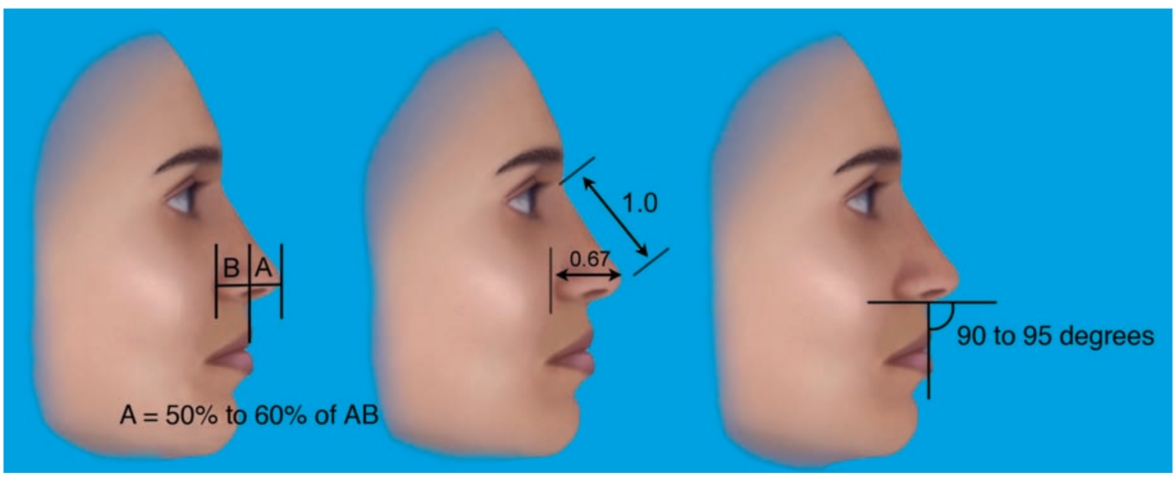


On lateral view, *A* (defined as the segment from the upper lip to the tip) is commonly greater than 60% of the distance from the alar-facial crease to the tip *(B);* the total distance is *AB* from the crease to the tip.[2] Nasal length is often disproportionately long relative to projection. This, along with caudal tip displacement, creates the appearance of inadequate tip projection. The nasolabial and columellar-labial angles are frequently less than 90 degrees, with a plunging tip.

Preoperative assessment and analysis of tip projection is complicated, and the use of accepted standards is warranted. However, evaluation may not always dictate the appropriate treatment. It is important to realize that the patient's tip projection may inherently be adequate and only appears inadequate as a result

of poor tip position. This is different from Asian and black noses, which have true tip underprojection as a result of poor tip complex framework. In Middle Eastern noses, the lower lateral crura and medial crura may actually be long and strong enough to allow proper or excess tip projection if the tip is simply rotated cephalically. However, since the tip complex is displaced caudally away from the anterior septal angle, the tip appears as if it may need significant maneuvers to improve its projection. This may set the stage for excess tip projection and an overall large nasal appearance. Most Middle Eastern patients' major complaint is that the nose is too large, making proper tip evaluation critical.

In addition to standard nasofacial analysis, an ethnically focused nasal analysis should focus on the specific nasal features of the Middle Eastern nose.[24] This analysis includes a systematic evaluation that is sensitive to the Fitzpatrick skin type, skin thickness and sebaceous quality, dorsum/radix position and contour, the adequacy of nasal length, the orientation and strength of the lateral crura, the presence of nasal deviation, nostril-tip imbalance, degree of alar flaring/sill excess, alar base position, columellar/medial crura length and integrity, and the presence or absence of a hyperdynamic tip (animated view).



Racial asymmetry/incongruity can be prevented by (1) correcting the nasolabial angle to no more than 95 degrees, (2) preventing the creation of a sharp supratip breakpoint, (3) performing a modest dorsal hump reduction, and (4) avoiding excessive nasal tip and alar base narrowing.

Nasofacial harmony can be achieved by correcting the complex interaction of all inherent imbalances.[2] As stated previously, avoiding racial incongruity is imperative. For example, the nasolabial angle should not be overcorrected (greater than 95 degrees), and tending toward underrotation of the nasal tip is often the safest approach (90 to 95 degrees) for both male and female patients. Many of the standard nasal ratios may be used as a guide for treatment and evaluation (not unlike rhinoplasty in a white patient), but certain endpoints differ, such as preventing a sharp supratip break. However, patients may verbalize specific details, such as wanting a more narrowed tip or retaining dorsal height.

Patient education and computer imaging software play an important role in the preoperative evaluation process for both the patient and surgeon. With thorough knowledge of the nasal morphology, the surgeon can use his or her own discretion and incorporate an individualized approach. For example, a sharper supratip break and more obtuse nasolabial and columellar-labial angles may be very aesthetically pleasing on some female Middle Eastern patients who have lighter hair color, thin eyebrows (natural or tweezed), and who have Fitzpatrick type II or III skin. The key is to not adopt a dogmatic approach but rather to recognize each nasal characteristic involved and discuss the proposed changes with the patient. Although some surgeons still advocate a closed rhinoplasty approach in this patient population, we feel that an open rhinoplasty approach has more advantages than disadvantages in allowing direct visualization of soft tissue and cartilage (particularly at the tip) and dorsal manipulation.[7]

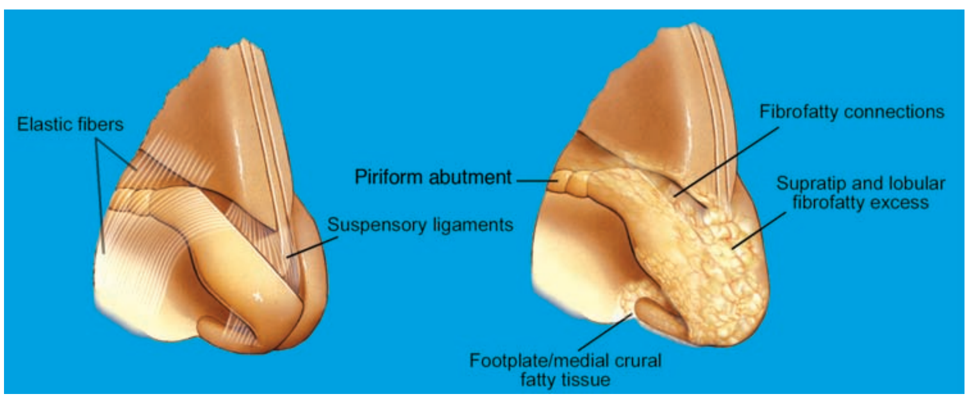
Although understanding the nasal morphology of Middle Eastern patients is crucial, an individualized approach that balances patient desires with the surgeon's aesthetic and artistic sense should always be used to prevent an undesirable outcome.

ANATOMIC COMPONENT EVALUATION

Skin and Soft Tissue Envelope

Patients commonly have Fitzpatrick type III to V skin. Middle Eastern patients, particularly those of the more Northern regions (Northern Iran, Armenia, and Turkey), can have lower Fitzpatrick skin types and features similar to those characteristic of Southeastern Europe and Asia. Nasal skin may be thick or thin. Skin texture tends to be highly sebaceous, particularly at the nasal tip, lobule, and alar rims. Oral tretinoin (Accutane) or topical retinoic acids may be prescribed in severe cases to reduce the density of sebaceous skin and may help prevent postoperative infections.

Preoperative and intraoperative evaluation usually demonstrates a moderate to large amount of fibrofatty tissue in the supratip, interdomal region, and between the medial crura. Wide soft tissue undermining is thus required to address all the potential sites of fibrofatty infiltration.



The abundant presence of intercartilaginous fibrofatty tissue may be partly responsible for the decreased stability and strength of the overall cartilaginous framework.[2] The fibroligamentous nasal attachments appear weakened by the plethora of fatty infiltration between the cartilaginous frame.[25] On external palpation, weakness of the tip cartilages and compressibility in the region of the domes often give a spongelike feel to the nasal tip and lobule. This is exaggerated when

the soft tissue sleeve is thick and heavy. The strength of the nasal base platform and medial crura can be assessed by placing direct pressure on the domes and pressing posteriorly toward the anterior nasal spine. There is frequently a lack of resistance as the tip-lobule complex easily collapses signifying a weak nasal base platform and support cartilage (that is, short middle and medial crura with caudal displacement from anterior septal angle). This may in part result from (1) the great amount of soft tissue weight relative to the underlying cartilaginous support framework, (2) caudally positioned infratip lobule and medial crura placing them at a biomechanical disadvantage, and (3) insufficient middle crura and medial crura.

Meticulous resection of intercartilaginous fatty tissue may allow greater stability when combined with strut grafts and nondestructive tip-suturing techniques. In addition, as with the black nose, extensive defatting and sculpting of the subcutaneous soft tissue envelope is often required.* This should not violate the subdermal plexus because irregularities and vascular embarrassment may ensue. Defatting of the nasal tip skin should always be selectively performed over regions in which underlying cartilage frame contours need to be externally more visible.

Soft tissue defatting should be performed deep to the subdermal plexus and is commonly required in the tip, supratip, and intercrural regions to help refine nasal tip contour and definition. This may also improve postoperative soft tissue contractility and adherence.

One of the challenges in Middle Eastern rhinoplasty is the poor contractile nature of thick, sebaceous skin. The thickest and oiliest skin is located in the supratip/tip region. Unfortunately, the region that requires the most contouring and definition from cartilage manipulation and postoperative skin/soft tissue contraction is also at the supratip and nasal tip. The poor contractile ability of this tissue and the excess skin present at completion of the rhinoplasty can lead to disappointing long-term results and is perhaps the most difficult component to control. Therefore it is essential that other more controllable and predictable steps be executed precisely, incrementally, and safely.[2,27]

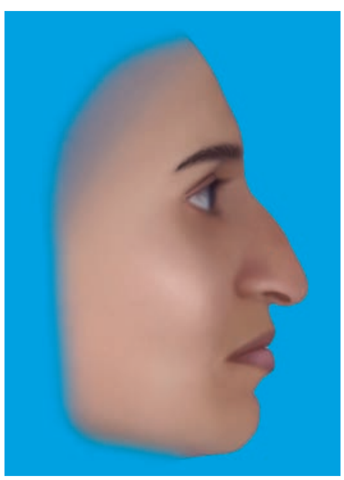
*References 1, 15, 16, 22, 26, 27-32.

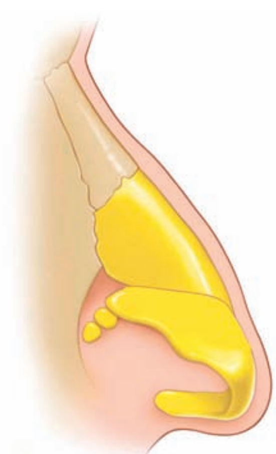
It is also important to recognize the full spectrum of soft tissue presentations in the Middle Eastern nose. Patients may have thin nasal skin as well, which should not be defatted. A thin nasal skin envelope may reveal undesirable contours, both in the early postoperative period and years following surgery. For example, lack of attention to creating a smooth dorsal contour after significant hump reduction may later reveal irregularities and bony edges through the thin skin. In addition, tip grafts should be carefully selected; soft or crushed grafts with beveled edges are best. Soft triangle facets may become sharper and lead to alar apex retraction during tip shaping or repositioning. Crushed grafts and subtle maneuvers in this area will lead to fewer long-term contour irregularities.

Rhinoplasty in Middle Eastern patients is complicated by a thick, noncontractile skin/soft tissue envelope. Using more predictable, controlled operative techniques will improve the long-term results. An unrecognized thin skin envelope produces the opposite effects, with undesirable framework and graft visibility.

Bony Pyramid and Nasal Dorsum

Commonly, the nasal dorsum is wide and high in a Middle Eastern patient. The dorsal hump has important contributions from the paired nasal bones, the ascending process of the maxilla, overall septal excess, and the upper lateral cartilages.





The contribution of each of these structures will dictate the degree to which each must be altered. A graduated component dorsal hump reduction technique is particularly effective so that the surgeon can directly visualize the magnitude of reduction attained in a safe, incremental fashion.[33]

An incremental technique in this ethnic population is critical, because excessive dorsum reduction will produce significant racial incongruity. Most Middle Eastern patients require as well as request conservative dorsal height reduction. It is not uncommon for the radix to be overprojected (in both males and females), and burring or rasping of the radix is often required to establish the proper dorsal height set-point.[34] It is critical that the balance between dorsal height and radix projection be maintained.

Overresection of one and/or the other will result in an unnatural appearance and overoperated look and can produce the appearance of increased intercanthal distance. One of the most common fears expressed by Middle Eastern patients during consultation is that an overly sloped or scooped dorsal profile will be created.

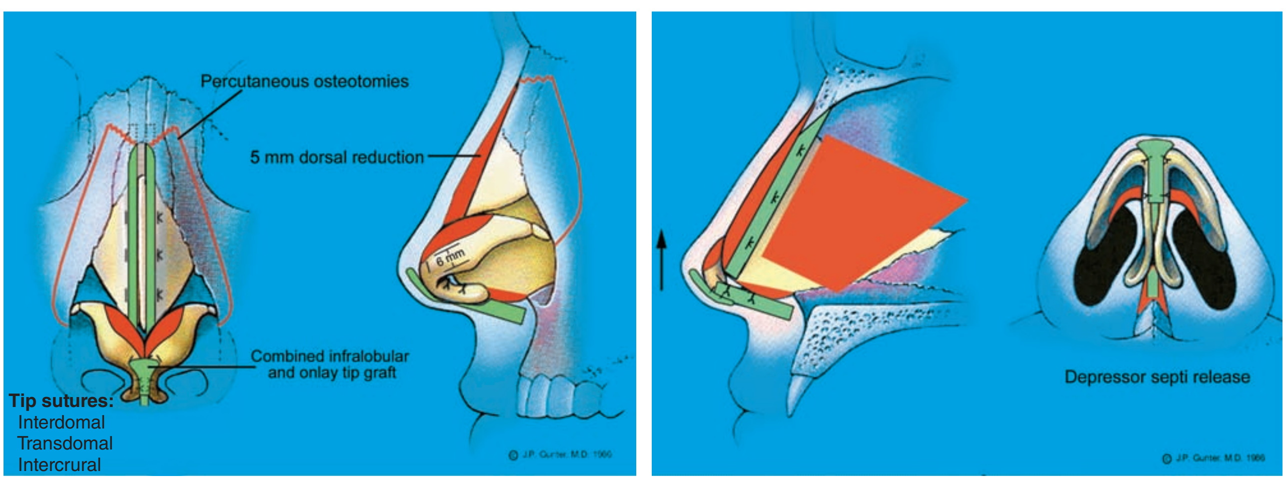
Osteotomies, if performed, are made using a low-to-low percutaneous perforated technique with a superior oblique extension, because the bony width commonly begins at the ascending process of the maxilla. The low osteotomy position helps avoid creating asymmetric/unbalanced dorsal aesthetic lines and a visible lateral bony step-off. Furthermore, reduction of the significant dorsal hump alone will lead to the appearance of greater upper and midvault width. Therefore osteotomies are required more often than not to close the significant open roof.

Septal deviations are common and should be surgically corrected. Septal reconstruction is usually necessary for both correction of septal deviations and cartilage harvest. Strong and straight harvested septal cartilage should be used for lateral crural strut grafts and other struts.

The role for spreader grafts has been reduced with the introduction of autospreader flaps, which are usually adequate to establish proper dorsal contour; they can have similar functional benefits.[35,36] Autospreader flaps are developed from the dorsal segments of the redundant upper lateral crura after component reduction and turned inward toward the septum. They can be scored or bent and sutured. When they are not scored, a springlike effect is created that is more powerful for improving internal nasal valve angle. However, in certain circumstances such as secondary cases, spreader grafts may still be optimal.

Case Analysis

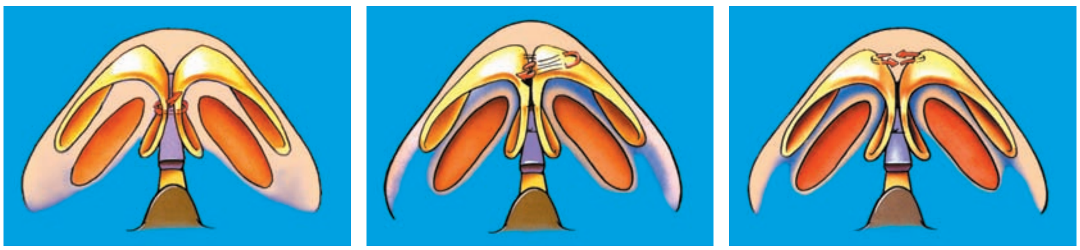
This patient requested increased narrowing and definition of her tip after her primary rhinoplasty.[2]



She required a secondary operation for further soft tissue defatting and replacement of a tip graft due to early resorption. Ten-year postoperative photographs demonstrate maintenance of dorsal height and tip definition obtained after secondary defatting and cartilage-shaping techniques. It would also have been just as acceptable in this patient to create less-narrowed dorsal aesthetic lines and more conservative tip refinement; however, it is important to listen to the patient's concerns. Note the lighter hair and eyebrow color in the postoperative photographs.

The presence of a cartilaginous and bony dorsal hump, inherent underrotation of the tip complex, and inadequate (appearing) tip projection exaggerate the magnitude of dorsal height. Understanding this dynamic relationship will help prevent overresection of the dorsum because some degree of balance is created by proper tip rotation and projection. A 6 to 10 mm tip (dome) apex-to-supratip dorsal height difference can be used as a preliminary guide. The balance in nasal contour on profile with the magnitude of dorsal reduction and tip position is critical.

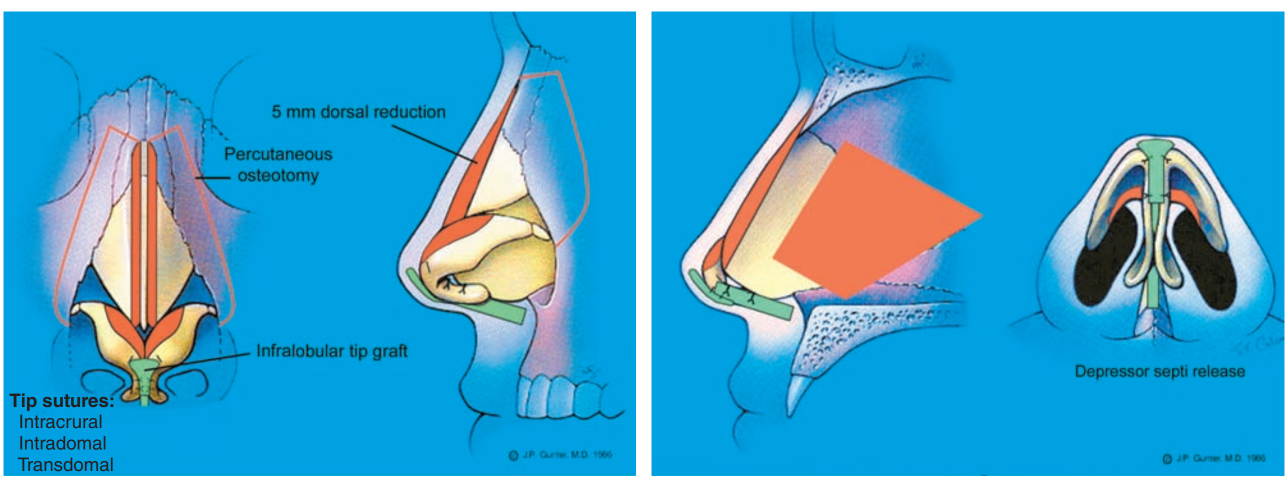
Nasal Tip



An ill-defined nasal tip that is bulbous or boxy with overlying thick skin mandates more aggressive tip modification techniques. Standard invisible and nonpalpable suturing and grafting techniques may be supplemented by more visible grafting techniques.[27,29,30-32] However, a sequential approach that begins with placement of a columellar strut graft, medial crural sutures, transdomal sutures, interdomal sutures, medial crura septal sutures, and tip grafting and ends with nostril/base shaping will improve the predictability of tip-shaping techniques in the Middle Eastern nose.[31,32] Thin-skinned patients require more subtle tip grafts or no grafting in the tip region. When indicated, soft triangle facets should be supported with customized grafts to hold the soft triangle facet open and prevent visible notching, because the tip sutures create a steal phenomena lateral to the tip complex. Excess domal width and angle of divergence often present concomitantly, which results in moderate to severe tip bulbosity and a lack of tip-defining highlights and contours. Even when the underlying domal width and angle of divergence appear adequate, the thickness of the overlying soft tissue/skin, particularly in the supratip, blunts the external contours, and multiple tip-suturing techniques should be used to simultaneously shape the tip and improve tip projection.[27] This serves as a foundation for tip shape that can be judiciously grafted for further tip refinement. A postoperative pollybeak deformity is not uncommon in this patient subtype, and steps should be taken to prevent this with proper tip positioning relative to the newly established dorsal height.

Case Analysis

This patient did not like her dorsal hump and ill-defined tip.[2]



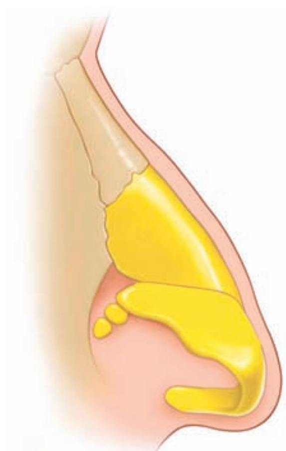
Sequential tip sutures, conservative cephalic trim (including domes), and an infratip lobule graft were used to produce a well-balanced tip, dorsum, and soft supratip break. Middle and medial crural insufficiency was corrected by a graft and columellar strut graft to achieve an aesthetic infratip lobule with proper volume and contour.

The patient is shown 1 year postoperatively with an improved dorsal profile and refined tip. More balance between the dorsum and tip has been achieved.

Patients may have lower lateral and medial crural cartilages that are weak relative to a heavy skin and soft tissue sleeve. These patients can also have insufficient middle crura. This increases the need for a columellar strut graft to lengthen and strengthen the columella and a Sheen-type onlay graft to create an adequate tip lobule (create the appearance of a strong middle crus) with a well-defined in-

fratip breakpoint. Insufficient middle (tip lobule) and medial crura (columella) can also limit the amount of tip projection and cephalad tip rotation, resulting in the propensity for postoperative loss of tip projection and definition if support structures are not augmented. It may be necessary to use a stronger columellar strut graft that is fixed or a septal extension graft.[37] Recognition of a disproportion of excessive soft tissue relative to the underlying cartilage is important. The cartilage frame is weakened by the dominating and heavy soft tissue envelope, which can have aesthetic and functional consequences if not addressed appropriately. Tip-shaping techniques that are nondestructive, preserve native cartilage integrity, and are augmentative should be used whenever possible. Strong support structures will help reduce the reliance on skin envelope contracture, which is limited in these patients.

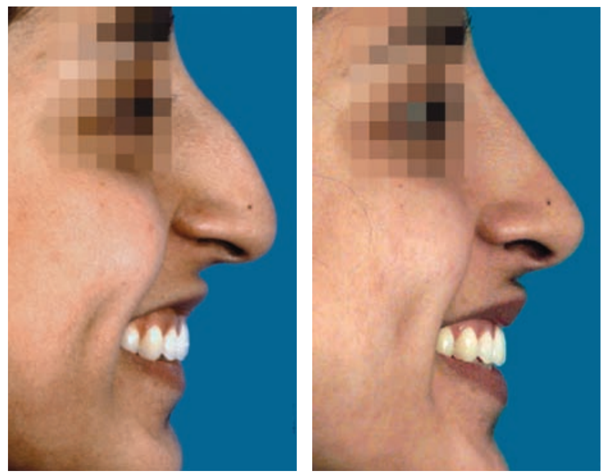
The lateral crura may be wide but commonly do not contribute substantially to overall alar arch strength because they are frequently oriented cephalad and vertical. This produces a biomechanical disadvantage to tip position, particularly with the pull from the typically strong depressor septi nasi muscle. When lateral crural malposition and arch shape cannot be shaped with cephalic trim alone, then transection at the accessory chain region along with caudal repositioning using a lateral crural strut and/or alar contour graft for added support are required.[38,39]



Furthermore, vertically positioned lateral crura may limit the amount of tip rotation unless an accessory chain transaction and lateral crural reorientation are performed. Toriumi[40] and Rohrich and Liu[41] place importance on the position of the cephalic lateral crural margin relative to the caudal margin. When the cephalic margin is oriented in a different plane than the caudal margin, then inherent lateral crural instability exists, which should be addressed before embarking on tip-shaping techniques.[40] Middle Eastern patients almost always lack supratip definition, and racial incongruity may result if a sharp supratip break is produced; this is true in both women and men.[2,10] Men should have a neutral

supratip region, and women should demonstrate a supratip that is not as sharp as in white women. A powerful maneuver to rotate the tip complex as well as achieve appropriate tip projection is lower lateral crural transection and repositioning. When the native lateral crura are strong, the addition of lateral crural strut grafts for support may be unnecessary.

Adequate tip rotation and shaping may be hindered by insufficient middle/medial crura and vertically oriented lateral crura. Transection and repositioning of the lateral crus may be necessary to improve the alar arch stability and contour.

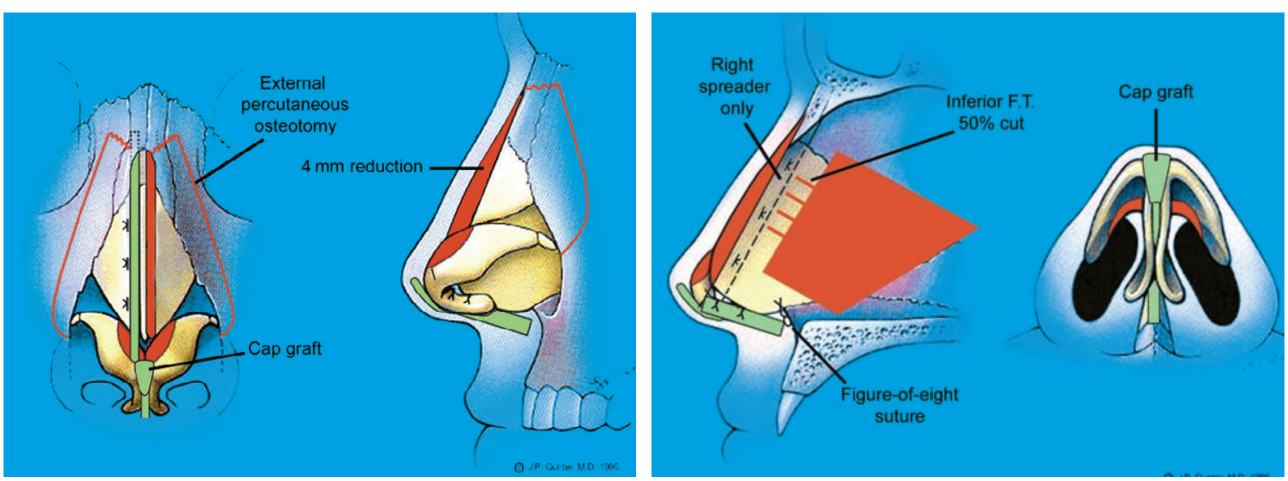


The depressor septi nasi muscle is often hypertrophied and results in a hyperdynamic nasal tip that can exaggerate the dorsal deformity as the tip rotates caudally and deprojects.[2,42] An aesthetic improvement in upper lip length (static and dynamic) can be achieved with depressor septi release or dissection and transposition.[42] It is unknown exactly to what degree the depressor muscle contributes to the plunging tip because so many concurrent rhinoplasty maneuvers can also elevate the tip, and isolated analysis of the depressor septi nasi muscle is currently being investigated using botulinum toxin A injection.[43]

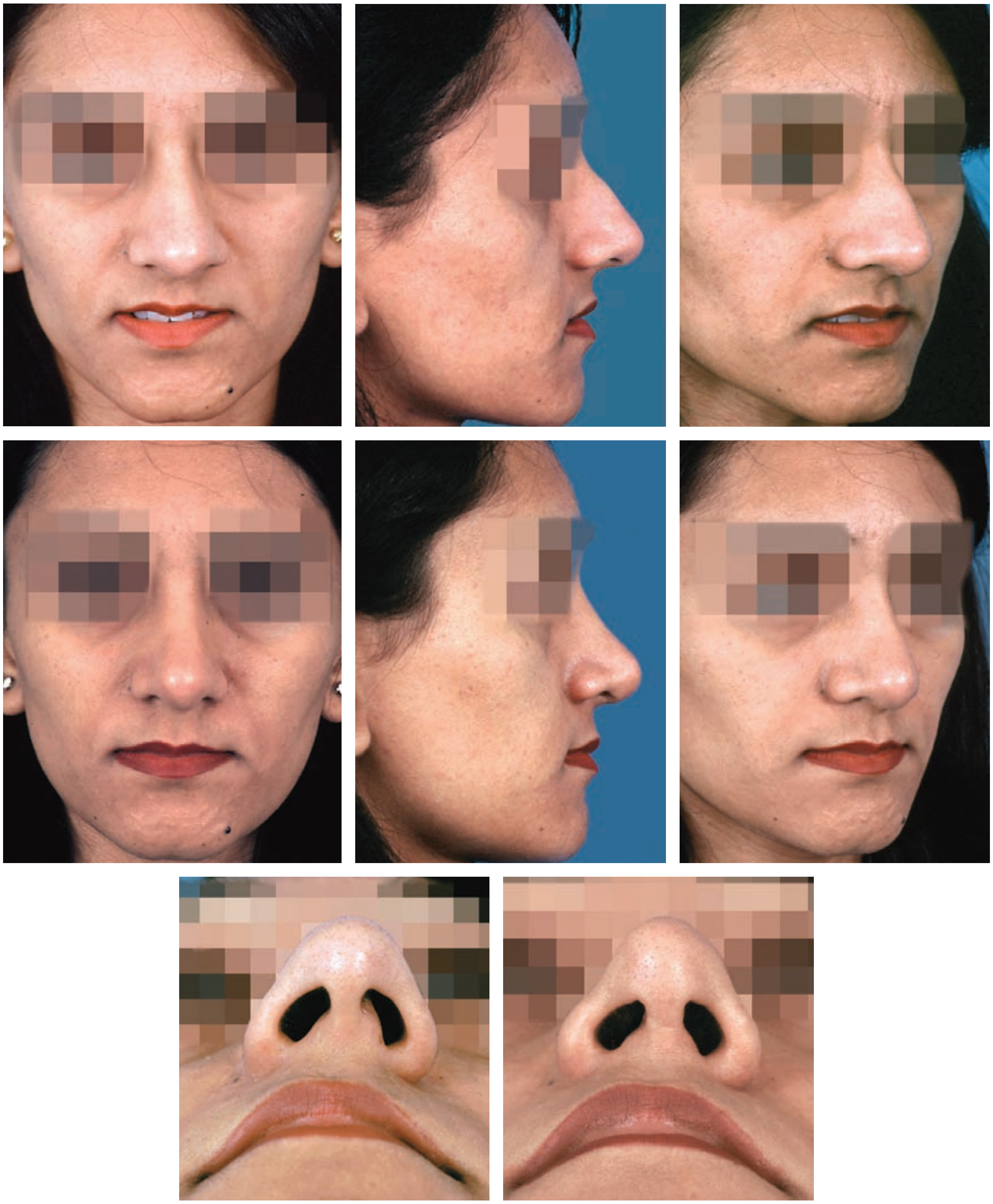
Depressor septi nasi muscle hyperactivity often contributes to and exaggerates a plunging nasal tip. Transnasal release or transoral dissection and transposition may be indicated.

Case Analysis

This patient underwent primary rhinoplasty to correct her dorsal septal reverse C-shaped deviation, a bulbous tip, dorsal hump, and a hyperactive depressor septi nasi muscle that produced a short upper lip.[2]

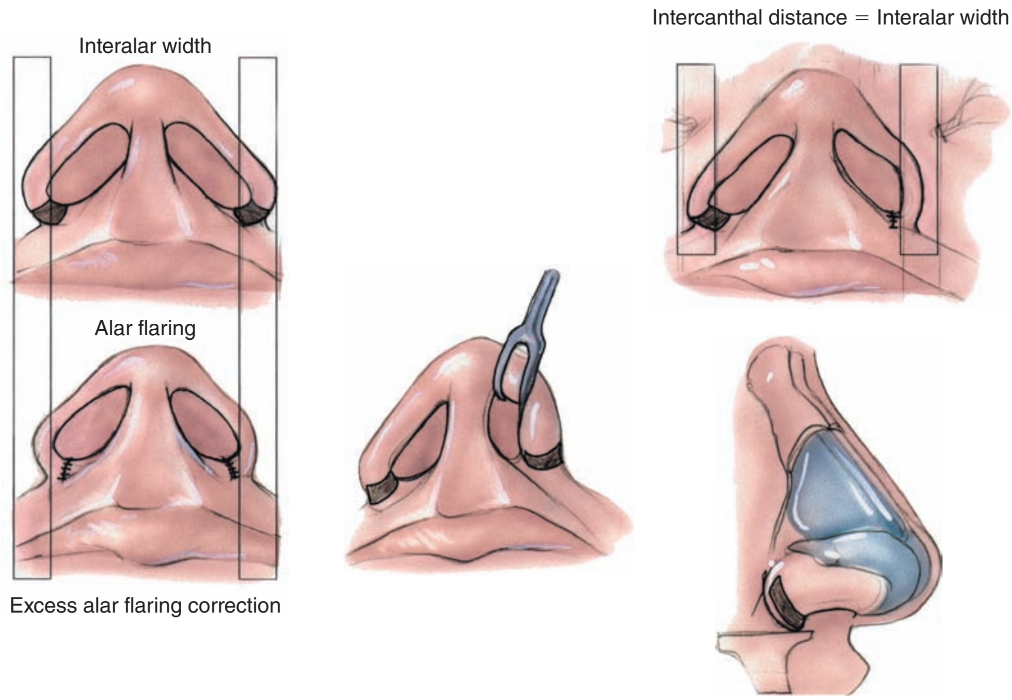


A moderate dorsal reduction, correction of her deviation, and tip-shaping using suturing and grafting (cap graft) techniques were performed.



She is shown 1 year postoperatively. Note the improvement in her nose-lip relationship after concomitant transoral depressor septi nasi muscle dissection and transposition.

Alar Base

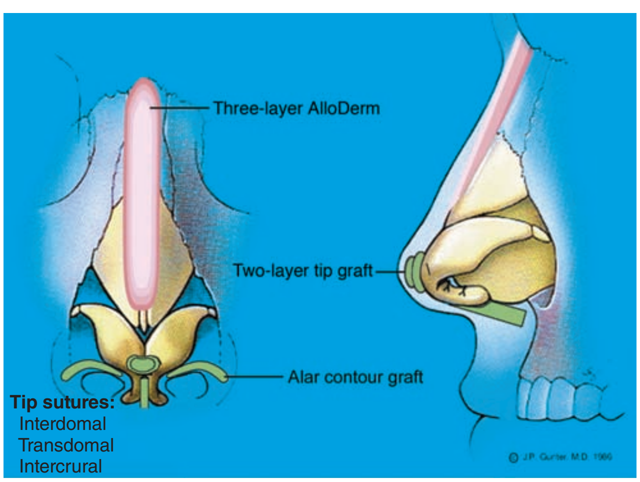


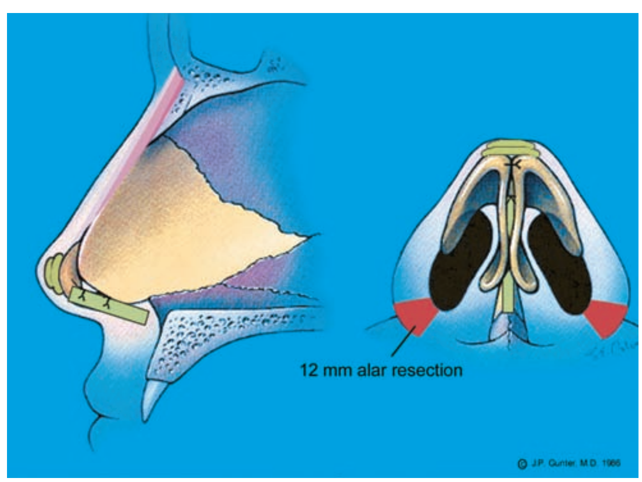
Alar flaring and/or increased interalar width is commonly seen. Conservative alar base surgery is required for nostril flaring, elongated nasal sidewalls, widened nasal base, large alae, and alar (nostril) asymmetry. If alar flaring (alar rim greater than 2 mm outside the medial canthal line) is present with normal nostrils, then flaring is corrected by limiting the excision to only the alar flare.

The resection should include a sill extension if interalar width is also increased. Isolated conservative sill resection may be all that is required in many cases. Excess sill tissue can be removed with a pie-shaped resection that does not extend into the lateral alar-cheek region. The surgeon should be aware of alar and nostril position and asymmetries. When alar flaring is present with excessive nostril size, a complete wedge excision that extends into the vestibule is performed. The excised amount must be carefully measured, and use of the halving principle and minimal skin edge eversion will improve scar quality. The alar base must not be excessively narrowed. Although this may be acceptable or even desired in white women, it will look awkward in the Middle Eastern nose and is a telltale sign of an overoperated, racially imbalanced nose.

Case Analysis

This patient demonstrates the wide spectrum of features of the Middle Eastern nose. Her very thick sebaceous skin, low dorsum, and wide nasal base more closely resemble the morphology of the black nose.





Alar base resections (12 mm) were performed to narrow her nasal base and improve the alar-columellar imbalance. A two-layer onlay tip graft, along with multiple tip sutures and alar contour grafts improved her overall nasal tip and alar arch shape. Correction of alar-columellar disharmony is essential; this disharmony often manifests as a hanging-columella deformity.[44] However, this patient has a thick and flared hanging ala.

Primary alar retraction is rarely seen in the Middle Eastern population.[2] Medial crural septal sutures may be required to correct excess columellar show and to improve or maintain tip rotation. Once again, care must be taken to avoid overcorrecting the nasolabial angle. Many Middle Eastern patients specifically request that their nasal tip not be overly raised. There may be a tendency to overcorrect because of the presence of a severe caudal tip position. Middle Eastern patients can have a prominent anterior nasal spine after the nasolabial angle is increased. Treatment of the nasal spine with fracture and excision may be required, because the entire columellar base is repositioned cephalad. In addition, scroll area and caudal septal vestibular resection may be required, because redundant mucosa can detract from the strength and stability of the repositioned tip complex. Vestibular lining does play a role in strengthening and maintaining nasal tip position and shape.

There also seems to be an increased frequency of alar base malposition in Middle Eastern patients.[2,10] The alar base is usually displaced cephalad relative to the plunging tip. With animation, this imbalance between the caudally dependent nasal tip and cephalically positioned alar base increases. It is important to recognize this imbalance and the degree to which it is decreased after performing adequate tip rotation and projection because the degree in which the alar base needs to be caudally repositioned decreases after appropriate nasal tip rotation is achieved.

Alar base flaring and malposition is common and should be corrected after the tip complex is properly shaped and positioned to prevent overcorrection.

Nostrils

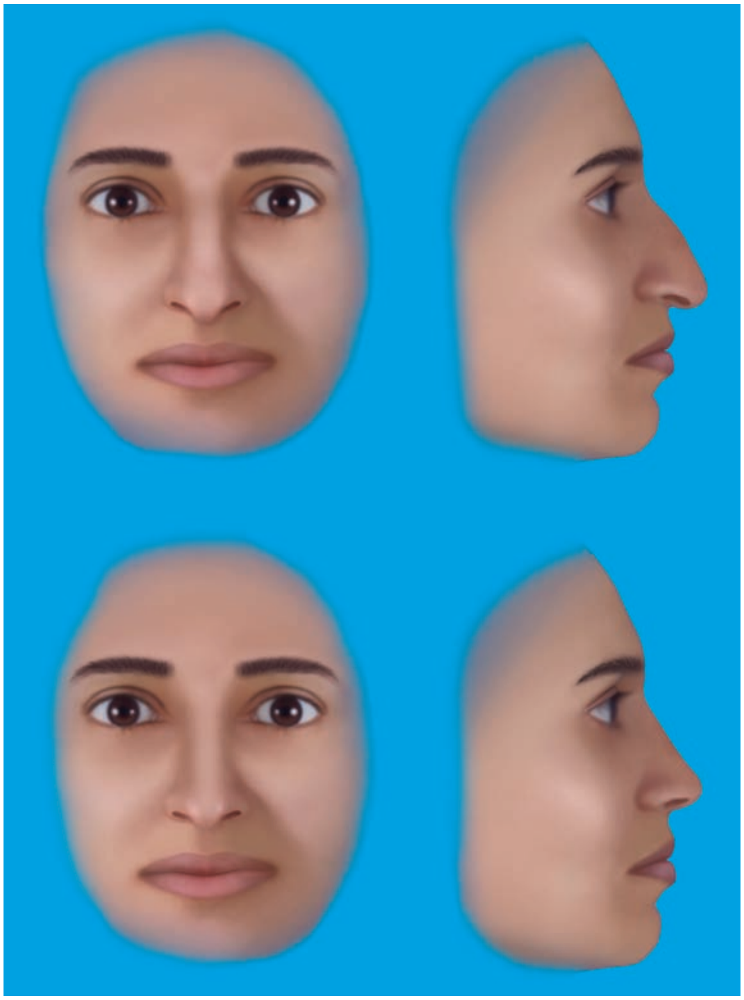
Nostril asymmetries are a frequent problem and are best evaluated using the basilar view. The disproportion often manifests as a tip greater than 40% and a nostril that is less than 60%. However, the nostrils should be assessed three-dimensionally on lateral, frontal, and basilar views to determine the exact nature of the asymmetry. In addition, nostril-tip balance should be carefully assessed preoperatively and intraoperatively. A nostril-to-tip ratio of approximately 60:40 should be achieved.[45,46] Residual nostril abnormality will become apparent after proper correction of tip rotation and projection, alar-columellar discrepancy, and alar base positioning.[44] This abnormality is often caused by flaring medial crural footplates, short nostril deformity (that is, soft triangle excess), or enlarged nostril aperture.[46,47]

Nostril-tip imbalance is common and should be addressed using appropriate, incremental nostril-shaping techniques.

A short nostril imbalance (relative to the tip-infratip lobule) becomes apparent on close inspection in the basal view.[46] When infratip lobule augmentation and tip projection are increased without addressing a short nostril, then a short nostril deformity may result. This deformity manifests as an appearance of excess tip-lobule bulk, as seen in the patient above. It can detract from tip refinement and will likely be interpreted as a bulky-appearing nasal tip. Secondary rhinoplasty that addressed the nostril-tip imbalance produced a more aesthetically pleasing nose.

The short-nostril deformity can also be corrected with soft triangle excision (when the nostril apex-to-dome distance is excessive) and/or tip-suturing techniques that elevate the nostril apices, as described by Guyuron et al.[42] Middle Eastern patients will recognize and point out nostril asymmetries on the basilar view (size discrepancies, footplate flaring/columellar base width); therefore any preoperative asymmetries should be thoroughly demonstrated and discussed during the preoperative consultation and informed consent process. Asymmetrical and excessive medial crural footplate flaring or size is commonly present and should be corrected using suturing techniques, with or without footplate excision.[26] Excess soft tissue that is present in the intercrural space should be directly excised and will allow improved nostril shaping.[26]

COMMON GOALS IN MIDDLE EASTERN RHINOPLASTY



A racially balanced and attractive postoperative result will not detract from overall facial harmony. Appropriate nasofacial balance is achieved without creating racial incongruity and an awkward, operated appearance.

Goals of Surgery

- Perform moderate dorsal reduction (avoiding overresection)
- Narrow the wide nasal bones
- Selectively debulk fibrofatty tissue (especially at the supratip and tip)
- Define the nasal tip through controlled, cartilage preserving techniques
- Avoid overcorrection of the nasolabial angle and excessive nasal tip rotation
- Address tip underprojection and poor definition by addressing rotation and insufficient middle/medial crura when present
- Recognize length discrepancies between the lateral and medial crura
- Address the hyperdynamic tip
- Address alar base through sill and/or alar flare reduction
- Correct nostril asymmetries

KEY POINTS

- Racial incongruity should be avoided by recognizing the nasal characteristics that are common among Middle Eastern patients and understanding the techniques that can help circumvent an overoperated nasofacial appearance.
- Recognition of thin-skin variations, particularly in the nasal tip, soft triangle, and rhinion, is important, and alterations to osteocartilaginous frame should be conservative, with contour camouflaging when indicated.
- Racial asymmetry/incongruity can be prevented by (1) correcting the nasolabial angle to no more than 95 degrees, (2) preventing the creation of a sharp supratip breakpoint, (3) performing a modest dorsal hump reduction, and (4) avoiding excessive nasal tip and alar base narrowing.
- Although understanding the nasal morphology of Middle Eastern patients is crucial, an individualized approach that balances patient desires with the surgeon's aesthetic and artistic sense should always be used to prevent an undesirable outcome.
- Soft tissue defatting should be performed deep to the subdermal plexus and is commonly required in the tip, supratip, and intercrural regions to help refine nasal tip contour and definition. This may also improve postoperative soft tissue contractility and adherence.
- Rhinoplasty in Middle Eastern patients is complicated by a thick, noncontractile skin/soft tissue envelope. Using more predictable, controlled operative techniques will improve the long-term results. An unrecognized thin skin envelope produces the opposite effects, with undesirable framework and graft visibility if this characteristic is unrecognized.

- Adequate tip rotation and shaping may be hindered by insufficient middle/medial crura and vertically oriented lateral crura. Transection and repositioning of the lateral crus may be necessary to improve the alar arch stability and contour.
- Depressor septi nasi muscle hyperactivity often contributes to and exaggerates a plunging nasal tip. Transnasal release or transoral dissection and transposition may be indicated.
- Alar base flaring and malposition is common and should be corrected after the tip complex is properly shaped and positioned to prevent overcorrection.
- Nostril-tip imbalance is common and should be addressed using appropriate, incremental nostril shaping techniques.

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The Asian Nose

Dean M. Toriumi ▪ Jaimie DeRosa

Augmentation rhinoplasty in an Asian patient requires an understanding of his or her aesthetic goals, which often differ from that of a white patient. Asian patients frequently desire dorsal augmentation and tip projection. To accomplish these changes, the surgeon must take into account the typical characteristics of the Asian nose. These include thick skin, abundant subcutaneous soft tissue, weak lower lateral cartilages, and a relative paucity of septal cartilage. Because typically the Asian nose has a relatively weak underlying structural support and a thick overlying skin and soft tissue envelope, the surgeon may find a structural approach to Asian rhinoplasty useful to achieve a refined dorsum and tip.

Rhinoplasty in an Asian patient requires attention to a unique set of aesthetic goals that differs from the goals for a white patient. The current ideal has shifted toward a more natural and refined look. Computer imaging is very important in this patient population to communicate proposed changes.

BACKGROUND

Traditionally, alloplastic implants have been used in Asian rhinoplasty to create dorsal height and tip refinement. The most commonly used alloplastic implant in Asia and throughout the world is composed of Silastic. Other materials, including Gore-Tex and Medpor, are also used for augmentation. In Asian rhinoplasty, the Silastic implant chosen is often L-shaped (dorsocolumellar implant) to create both dorsal height and tip projection.

This patient had two Silastic implants placed on top of each other. These implants were removed and replaced with a costal cartilage dorsal graft.

Although most patients do well over their lifetime with alloplastic implants, implants cause significant problems in a subset of patients. These problems can include infection, inflammation, thinning of the overlying skin, displacement, extrusion and chronic pain or pressure.[1,2] For example, the Silastic dorsocolumellar L-shaped implant can cause overlying tissue necrosis at its genu, acting as a pressure point on the nasal tip skin.[1] Moreover, this alloplast is unable to preserve nasal length, which can create a foreshortened nose over time. Because of these potential problems, we prefer to use autologous cartilage for all grafting in rhinoplasty.

There is a trend in Asian augmentation rhinoplasty to use isolated alloplastic dorsal implants and autologous cartilage for the nasal tip and mobile areas of the nose. This is a safer option as the Silastic dorsal implant is relatively well tolerated by the thicker Asian skin. Silastic dorsal implants are still moveable postoperatively and are at risk for infection or extrusion.

The Asian nose often has deficient structural support of the nasal tip and dorsum, which must be augmented to achieve the desired refinement. A structural approach to Asian rhinoplasty allows the surgeon to accomplish these goals.

Autologous cartilage grafting material used for augmentation Asian rhinoplasty comes from three main sources: septal, auricular, and costal cartilages. In older patients, irradiated costal cartilage may be needed to achieve augmentation, because costal cartilage in patients over 65 years of age may be ossified.[2] The degree of calcification can be assessed by performing a preoperative CT scan of the chest. Although the harvesting and carving of autologous cartilage grafts may increase the duration of the operation, the use of autologous grafting is an excellent option for most Asian patients undergoing augmentation rhinoplasty.

The options for materials for augmentation should be discussed with the patient. The pros and cons of using alloplastic implants versus autologous materials can be explained to the patient so that he or she can then make an educated decision.

INDICATIONS AND CONTRAINDICATIONS

Patients interested in rhinoplasty must be carefully evaluated to determine whether they are candidates for the procedure. Some patients should not undergo surgery for a variety of reasons.[3] Although most Asian patients in good health and with realistic expectations are good candidates for rhinoplasty, those with immunologic disorders that affect cartilage, such as relapsing polychondritis, or those with unrealistic goals should be advised against surgery.[1] Patients who have undergone previous surgery should be counseled on the complexity of their repair. Computer imaging can be used as a tool to help assess patients' expectations and whether they are good candidates. Many Asian patients will bring in photographs of celebrities with noses they consider ideal. The surgeon can derive a clearer indication of the patient's expectations based on the photos he or she brings in.

PREOPERATIVE ASSESSMENT AND PLANNING

One must take the time to understand the goals of the patient and carefully communicate the proposed surgical changes, which may include alterations in the radix, height of the dorsum, tip projection and rotation, nasal tip contour, nasal base width, nasolabial angle, and alar-columellar relationship. Computer imaging is critical to enhance the discussion between the physician and patient and can help to ensure that both have a similar understanding about the proposed changes and surgical goals. To reduce the risk of patient dissatisfaction, the surgeon should only show realistic changes with the computer imaging. The imaging should reflect what the surgeon feels can be accomplished.

Most Asian patients who seek rhinoplasty are in need of dorsal augmentation and nasal tip refinement. Augmentation of the nasal dorsum will increase dorsal projection and create a narrowing effect on frontal view. In most patients we prefer not to perform osteotomies, because a wider base will allow better transitioning from the dorsal graft to the maxilla. This transition from a narrower graft to a wider base will accentuate shadowing along the sidewall of the nose and provide a natural-appearing nasal dorsum.

Occasionally an Asian patient may have a dorsal hump. In many of these patients there may be a deficiency in their radix and nasal tip. Enhancing tip projection and augmenting the radix may provide the best improvement in the profile. This is discussed further in the Case Analyses section, p. 1249.

Once the surgeon has determined that the plan is to augment the nose, he or she must determine the material to be used (alloplast versus autograft). During the preoperative evaluation, the surgeon should discuss with the patient the options for materials that can be used. Specifically, these options should include the use of both alloplastic and autologous implants, along with the advantages and possible complications of each.

In our practice, we do not use alloplastic implants in any rhinoplasty. The patient should be made aware of the possible complications from the use of autologous grafts as well. When costal cartilage is needed, the patient should be informed of the risks of its harvest and use, which include warping, hypertrophic scarring, pneumothorax, and pneumonia.

Although alloplastic implants have been widely used in Asian rhinoplasty, the current trend is away from the use of such materials. Autologous cartilage for grafting—harvested from the septum, auricle, and rib—is being used more frequently in the Asian nose. Alloplastic implants are being used less frequently in the mobile lower third of the nose.

OPERATIVE TECHNIQUE

Augmentation rhinoplasty is typically performed through the external/open approach, with the patient under general anesthesia. For local anesthetic, 1% lido-

caine with 1:100,000 epinephrine is injected into the graft harvest site (septum, auricle, and/or rib) and into the nose. When using the open approach, we inject the columella, over the tip, along the marginal incisions, and over the dorsum. We also inject along the ascending process of the maxilla if we plan to perform lateral osteotomies. We routinely pack the nose with pledgets that have been lightly sprayed with a vasoconstrictive agent. We allow at least 10 minutes for the local anesthetic to take effect before making an incision.

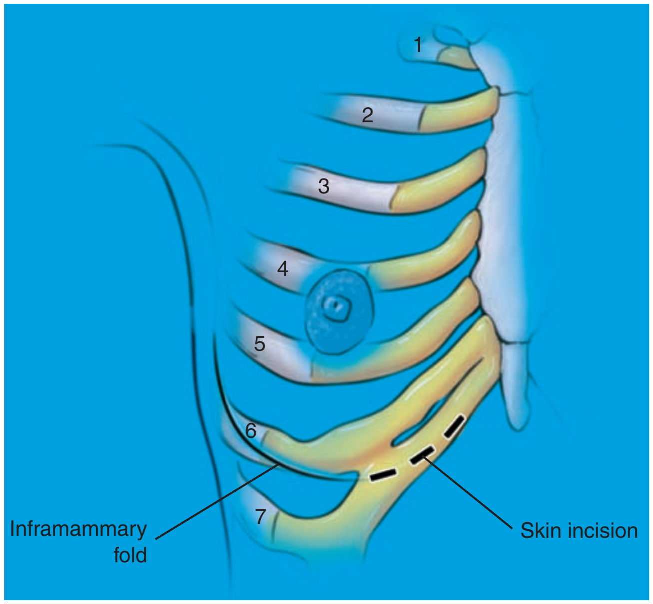
During our initial assessment, we can usually determine the type and amount of autologous cartilage that will be needed, which facilitates accurate preoperative planning and discussion with the patient. As noted, Asian patients typically have a smaller amount of cartilaginous septum compared with white patients. Nevertheless, septal cartilage may be adequate in Asian rhinoplasty when only a small amount of dorsal augmentation is desired. The septal cartilage can be harvested through a Killian incision (if a closed approach is used) or after dissecting between the medial crura to expose the septum.

If the surgeon is concerned about controlling tip rotation as tip projection is increased, dissection between the medial crura allows eventual placement of a caudal septal extension graft to stabilize the tip and prevent excessive tip rotation.

In instances in which there is insufficient septal cartilage, auricular and/or costal cartilage may be needed. The decision of which cartilage source to use is primarily based on the amount and location of augmentation needed. In patients who need only a mild degree of dorsal augmentation (less than 3 mm), septal or auricular cartilage can be used.[1]

A double layer of septal cartilage and/or auricular cartilage may provide up to 4 mm of dorsal height. The cartilage is stacked and sutured together using 6-0 Monocryl to provide additional dorsal height. However, when more than 4 mm of dorsal augmentation is needed, costal cartilage is preferred for grafting. In addition, patients who require premaxillary augmentation or lengthening typically require costal cartilage grafting to achieve the desired results.

Costal Cartilage Harvest

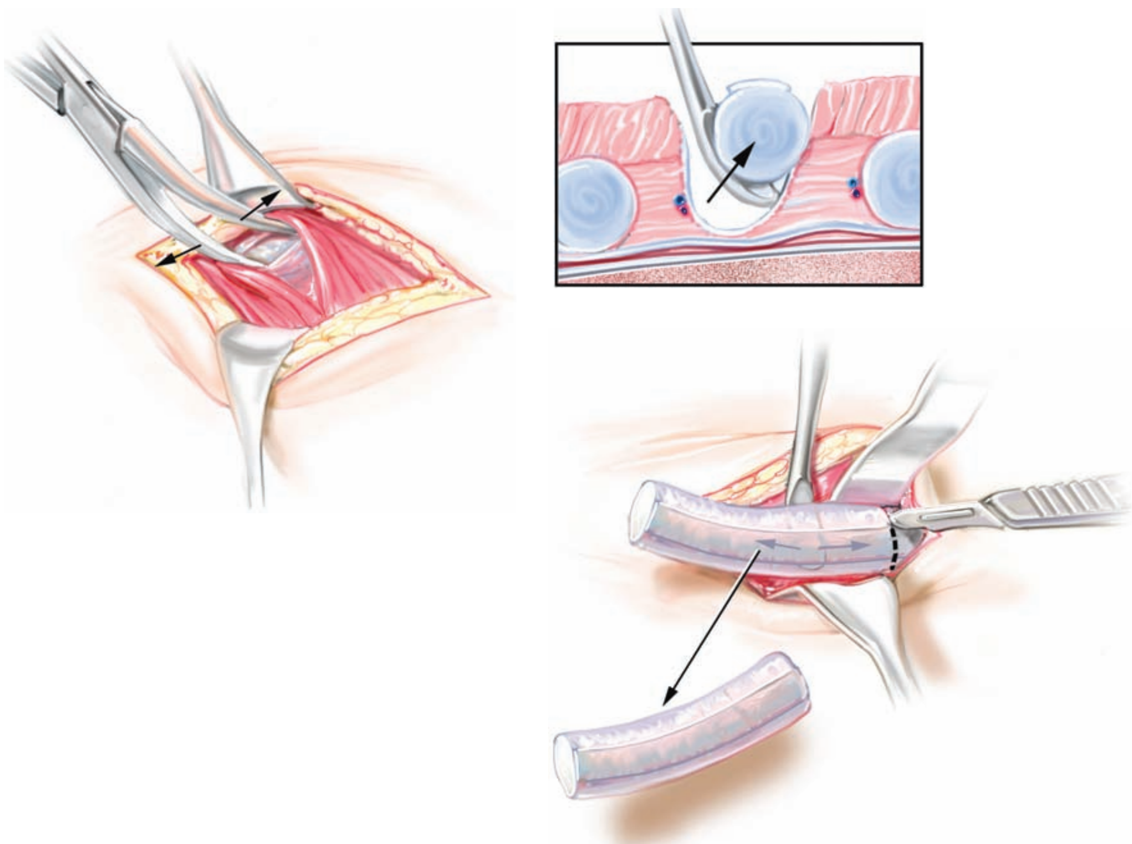


When costal cartilage is needed for nasal augmentation, the sixth and/or seventh rib is typically used. The chest can be palpated before the incision is made to decide which rib would be most appropriate for the desired augmentation. In women with no history of breast augmentation, an 11 mm incision is made along the lower aspect of the right breast. This permits the patient to hide the incision under a bra or two-piece bathing suit postoperatively. Asian patients tend to have smaller breasts and may not have a defined inframammary crease. We have gone to this type of small incision to aid in scar camouflage.

Chest scars in general do not heal well in Asian patients. If a small incision is made, it will be more conspicuous. For safety reasons, a larger incision should be made until the surgeon feels very comfortable with rib cartilage harvest. In patients with breast implants, the incision must be made inferior to the implant to avoid damage to the implant.

The risk of implant damage should be discussed preoperatively with these patients. If a patient is planning on getting breast implants, we make the incision lower on the chest to anticipate displacement of the inframammary crease once the breast implant is placed. In men, the incision is placed over the rib to be harvested. We typically harvest a piece of costal cartilage that is 4 to 5 cm in length.

Before the incision is made, a 1½-inch 27-gauge needle can be used to percutaneously palpate the rib cartilage to assess the degree of calcification and to identify the osteocartilaginous junction. Identifying the junction is important, since its location can be variable, and with smaller incisions the placement must be immediately above the segment to be harvested. Needle palpation must be done very carefully, because the needle can pass between the ribs and perforate the pleura, creating a pneumothorax. To prevent damage to the lung, finger palpation can be used to identify the sixth rib; then the needle is precisely directed into the rib, taking care not to go through the rib or between the ribs.



An 11 mm incision is made through the skin and subcutaneous tissue. The breast tissue is sharply dissected down to the muscular fascia. The fascia is incised sharply, and the muscle fibers are carefully spread parallel to the direction of the

muscle fibers. The muscle fibers are separated and not cut, which helps to reduce postoperative discomfort. Once the rib is identified, the remaining overlying tissue is carefully swept off of the rib. A strip of perichondrium can be harvested from the surface of the sixth rib before harvesting the rib.

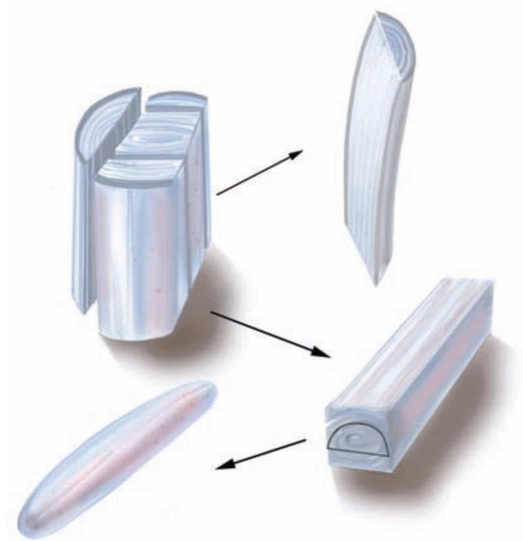
The perichondrium is very important and is used to help fixate the dorsal graft and also can be used to camouflage the lateral margins of the dorsal graft. Then a Freer elevator is used to begin the elevation of the perichondrium off the upper and lower margins of the rib. It is helpful to take a very thin (less than 1 mm) cuff of the cartilage with the perichondrium. This cuff of cartilage will aid in the dissection and protect against perforating the perichondrium on the back surface of the rib. By leaving the perichondrium intact, the pleura is not damaged.

The osteocartilaginous junction of the rib can be identified with a 27-gauge needle; the junction usually has a slightly darker color. The remaining perichondrium is carefully elevated off the undersurface of cartilage to be harvested, similar to the way in which a mucoperichondrial flap is elevated off of the nasal cartilaginous septum. Extreme care should be taken to dissect the perichondrium off of the rib, which lies between the rib cartilage and the intercostal neurovascular bundle and pleura.

Once the costal cartilage is isolated, medial and lateral cuts are made through the cartilage, and the remaining perichondrium attached to the undersurface can be dissected away from the rib, allowing its removal. The rib is set aside in antibiotic solution before carving. The sixth rib typically has a connection to the seventh rib and must be divided sharply with a Freer elevator before removing the rib cartilage. The ends of the rib are trimmed with a Takahashi forceps to remove any sharp or palpable edges. This step is especially important in thin patients. The wound cavity is then filled with antibiotic solution, and positive pressure ventilation is performed by the anesthesiologist to confirm that the pleura is intact. If air bubbles are seen, there may be a pleural defect. The wound is closed over a red rubber catheter attached to a suction system. With the chest expanded, the catheter can be removed.

The wound is closed in multiple layers. The muscle layer is tightly closed with 3-0 PDS suture, which helps to support the chest harvest site. This tight closure will create a splinting effect on the chest, significantly decreasing postoperative pain. The subcutaneous tissue is closed with 4-0 and 5-0 PDS simple interrupted sutures. The skin is closed with a 6-0 running vertical mattress nylon suture, which is removed on the seventh postoperative day.

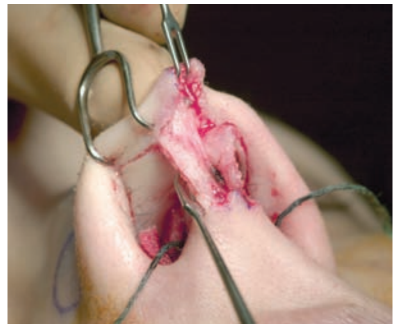
Carving of Costal Cartilage



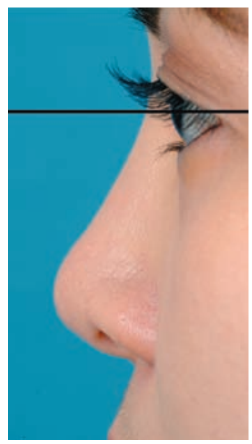
The perichondrium is carefully removed from the cartilage and set aside in antibiotic solution. The surgeon must then determine what grafts are needed, which will influence the manner in which the costal cartilage is carved. Typically the teaching is that the primary graft, or in the case of the Asian patient this would be the dorsal graft, should be taken from the central core of the rib. We have not found this to be the case. We typically cut the rib into three segments and then choose the best segment for the dorsal graft. In most cases the dorsal graft should be curved to allow identification of the tendency to bend. If a very large dorsal graft is needed, the graft can be carved from the central core of the rib. The strips taken from the periphery will tend to warp toward the periphery. The large dorsal graft can then be carved from the central core of the cartilage in a sequential fashion. Sequential carving of the dorsal graft and soaking the cartilage for approximately 20-minute intervals will allow the surgeon to note the tendency for curving. Ideally the dorsal graft should have a slight tendency to curve, allowing placement of the concave side of the curvature against the bony dorsum.

AUGMENTATION RHINOPLASTY

Augmentation rhinoplasty in the Asian nose can be performed using a closed or open approach. In general, if only dorsal augmentation is necessary, the closed approach is a reasonable option. More commonly, however, tip work is also desired, which we prefer to perform using the open approach.

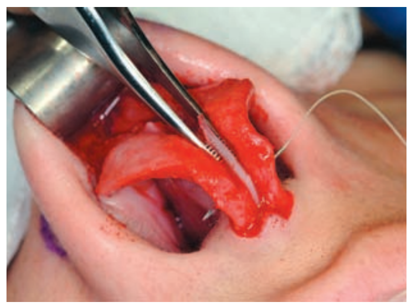
For open rhinoplasty, an inverted-V incision is made along the midcolumella, taking care to not damage the medial crura. Using three-point countertraction, the columellar flap is carefully elevated off of the domes, and the incision is connected to the infracartilaginous incisions.[4] The middle vault is exposed with dissection just over the middle vault cartilage.

When dorsal augmentation is required, a tight pocket is made along the bony dorsum, deep to the periosteum, using a Joseph periosteal elevator. Limiting dissection of the periosteum will create a very tight tunnel that will limit movement of the dorsal graft. It is very important that the subperiosteal pocket be in the midline as the pocket will dictate the position of the dorsal graft. In the Asian patient, the nasal starting point should be at or below the midpupillary line, which should then also mark the upper limit of dissection of the periosteal pocket.

In secondary Asian rhinoplasty, the surgeon may encounter alloplastic implants along the tip and/or dorsum, which are removed before augmentation. Dissection must be meticulous when removing alloplastic implants; the overlying skin/soft tissue envelope must not be damaged. A fibrous capsule surrounding the implant may be encountered and should be carefully removed.

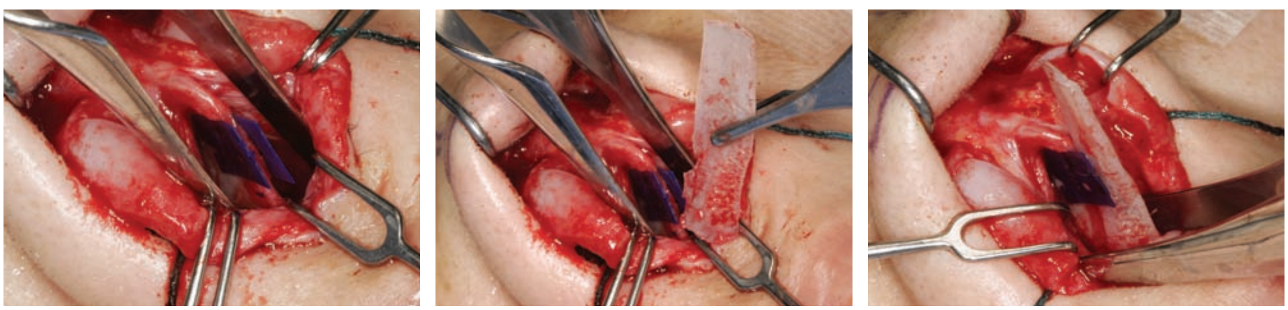
If the dorsum was previously augmented, the surgeon may need to work with a larger than ideal bony dorsal pocket into which the graft must sit. In this case, it may be necessary to use a threaded K-wire to fixate the dorsal graft to the underlying bony dorsum.



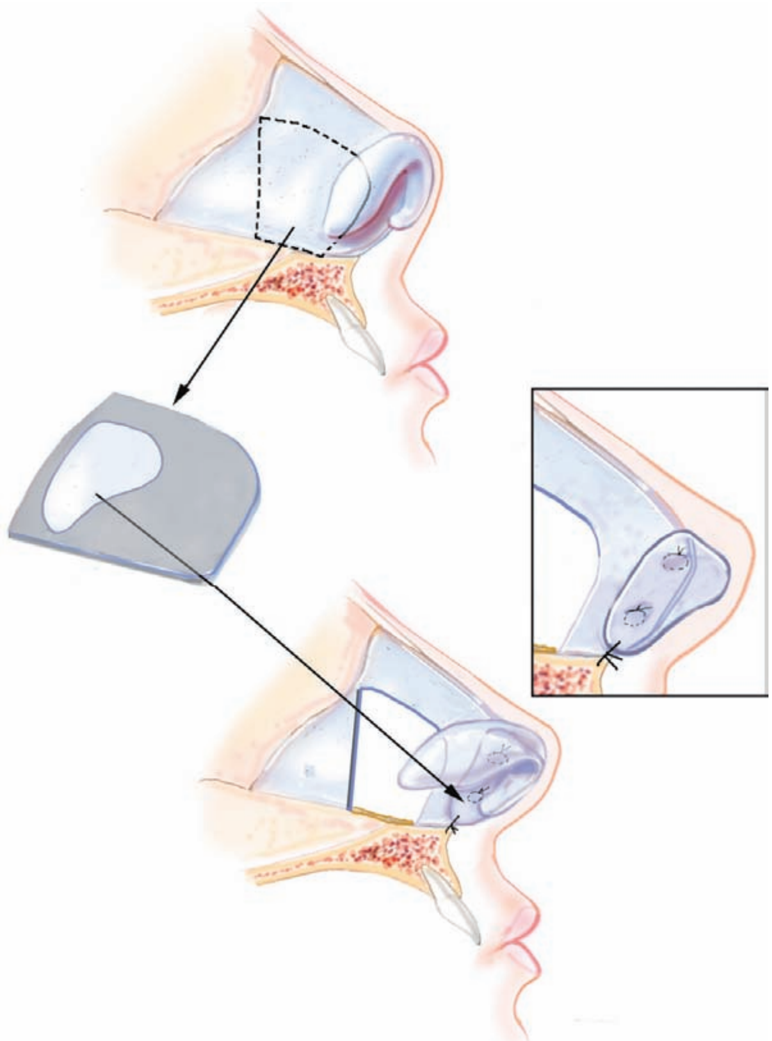
Once the nose is adequately exposed, the surgeon must decide how to stabilize the nasal base. A columellar strut graft may be used in patients who have appropriate tip support, nasolabial angle, rotation, and alar-columellar relationship. This graft can be placed in a pocket between the medial and middle crura, leaving soft tissue between the graft and the anterior nasal spine. The cushion of soft tissue will prevent the clicking sound that results from the graft shifting over the anterior nasal spine.

This graft is usually crafted out of septal or costal cartilage and typically measures 5 to 12 mm long, 3 to 6 mm wide, and 1 to 3 mm thick. It is fixed into place using a 4-0 plain gut suture on a straight septal needle, which is passed between the vestibular skin, medial crura, and graft. The columellar strut graft provides some tip support but will have little long-lasting effect on tip position.

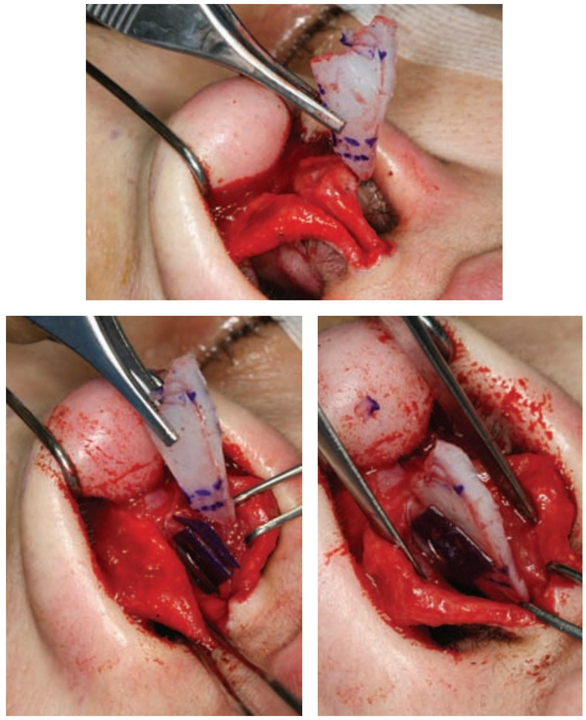
More commonly, the Asian nasal tip requires further augmentation. If the patient has poor tip support, an acute nasolabial angle, and/or an inadequate alar-columellar relationship, a caudal septal extension graft is used.[5,6] This graft can be carved from septal or costal cartilage. The exact configuration of the graft depends on the specific needs for augmentation. If tip support is needed without a change in rotation or nasolabial angle, then the caudal septal extension graft can be rectangular in shape.



The graft should be placed end to end and fixated with splinting grafts of thin costal cartilage. If no slivers of rib cartilage are available, a resorbable 0.25 mm thick PDS plate can be used to splint the septal extension graft in place. These plates are not perforated, so a 16-gauge needle can be used to make holes in the PDS plate to allow vascular ingrowth and fibrosis to develop to stabilize the extension graft.

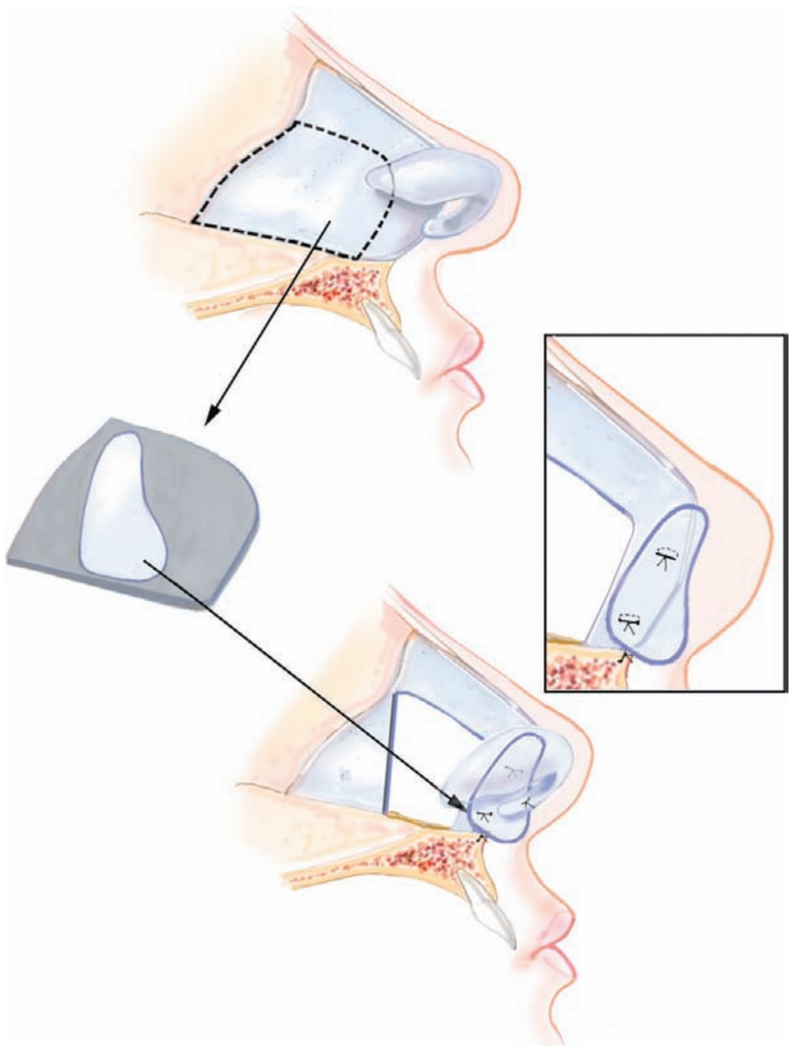


In patients who require nasal tip counterrotation without altering the nasolabial angle, the graft should be longer along the superior margin. Asian patients tend to have an overrotated nasal tip.



Correction requires the placement of a caudal septal extension graft that is longer along its superior margin and shorter along the base. This maneuver will act to counterrotate the nasal tip and increase nasal length. The graft is placed end-to-end and sutured to the caudal margin of the nasal septum. The medial crura are fixed to the caudal margin of the septal extension graft.

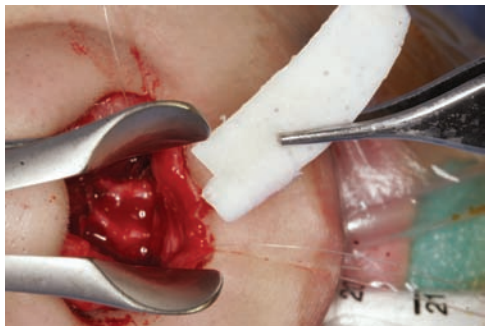
As nasal tip projection is increased the nasal tip will tend to rotate upward, because the tip cartilages in the Asian patient are weak and soft, and the caudal septum tends to be cephalically positioned. This lack of cephalic support requires a downward force to prevent excessive tip rotation as projection is increased.



For patients who have an acute nasolabial angle and need rotation, the graft can be made longer inferiorly. Correction requires placement of a caudal septal extension graft that is longer along the inferior margin and shorter along the superior border, which will push out the nasolabial angle and rotate the nasal tip. The graft is sutured to the caudal septum in an end-to-end orientation, and the medial crura are sutured to the caudal margin of the septal extension graft.

Another way to open an acute nasolabial angle is to advance the medial crura on the septal extension graft. As this is done, the nasolabial angle will become more obtuse. However, this maneuver should be avoided in patients with a shorter upper lip.

Once the septal extension graft is fixed in place, the medial crura are sutured to the caudal margin of the graft using a 4-0 plain gut suture on a straight septal needle. Proper alignment should be rechecked, and, if correct, the position can be firmly set using a 5-0 PDS suture placed along the inner surface of the medial crura and caudal edge of the graft. Again, tip symmetry should be confirmed. Care must be taken so the caudal margins of the medial crura are aligned and the domes are aligned.



In patients who have a severe lack of tip support and a deficient premaxilla, an extended columellar strut graft with or without a premaxillary graft can be used. Costal cartilage is used to create the extended columellar strut graft, because this graft must be very strong. The graft must also extend from the premaxilla to the final position of the cartilaginous domes, and a long piece of cartilage is typically required. The extended columellar strut graft typically measures 25 to 50 mm long, 5 to 10 mm wide, and 3 to 5 mm thick. The extended columellar strut graft is placed between the medial crura, sutured into a notch in the anterior nasal spine. The notch in the nasal spine can be made deeper using a 5 mm straight osteotome. Care should be taken not to fracture the anterior nasal spine. The graft can be sutured using two 4-0 PDS sutures placed through surrounding soft tissue or through a hole made in the nasal spine with a 16-gauge needle. Stable placement of the graft can also be achieved by suturing the graft to two thin pieces of cartilage that sit on either side of the nasal spine.

The inferior aspect of the graft can also be flared and fashioned with a midline groove that sits on the anterior nasal spine. These techniques will help to stabilize the extended columellar strut graft on the anterior nasal spine and keep it from shifting. If such a graft should shift off the midline, the entire nasal tip and columella will be tilted as well.

In many cases spreader grafts can be placed and extended beyond the existing caudal septum and then used to stabilize the septal extension graft. Because most Asian patients do not need widening of the middle vault and there is no need to open the middle vault, spreader grafts can be placed into submucosal tunnels. The spreader grafts will slip into the tunnels and will stabilize the extension graft.

Once the extended columellar strut graft is fixed to the nasal spine and to the caudal septum, the medial crura can be advanced anteriorly and sutured in place using a 5-0 PDS suture. This step will help to further increase nasal tip projection and blunt the nasolabial angle. It should be noted that this maneuver will also tend to increase tip rotation. Therefore, if no rotation is desired, the medial crura can be sutured to the graft in a neutral position.

The nasal tip must often be augmented to provide increased support using a variety of grafting techniques including the columellar strut graft, the caudal septal extension graft, and the extended columellar strut graft.

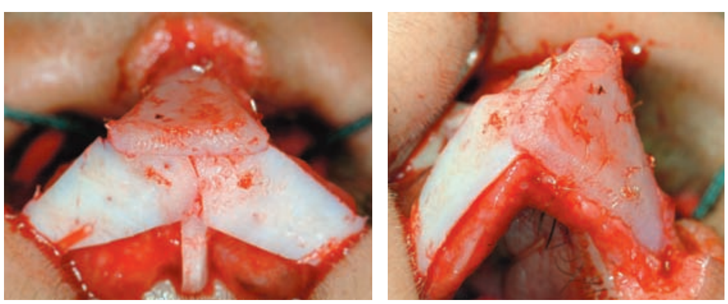
Managing the Nasal Tip Lobule

With the tip stabilized, tip contour can be addressed. Nasal tip contour can be improved by using one of several techniques. In patients with relatively thin to medium skin thickness, dome sutures may be sufficient to help improve the tip projection and shape. More commonly, however, the Asian patient has relatively thick skin at the nasal tip and needs both projection and improved tip contour. The surgeon must then use other techniques to create an appropriate tip shape.

The first option would be an onlay type of tip graft. This is typically a rectangular cartilage graft that is placed on top of the domes and sutured with two 6-0 Monocryl sutures. This graft can be soft cartilage that is gently crushed or the cephalic trim of the lateral crura. One or two layers can be applied. The grafts should be approximately 8 to 10 mm wide to provide a normal-appearing tip contour.

If the patient has very thick skin or needs additional projection, a shield-shaped tip graft can be fashioned from cartilage and used to increase projection.[7] It is sutured to the caudal margin of the medial crura and domes using at least four 6-0 Monocryl sutures. The graft should taper at the edges, be thicker at the anterior leading edge and thinner at the posteroinferior margin, and have a subtle cephalic or upward curvature. These modifications will help create the proper tip shape and appropriate columellar-lobular angle.

To minimize the chance of tip graft visibility, several additional modifications are often necessary. A buttress (cap) graft can be placed immediately behind the leading edge of the tip graft, helping to stabilize the tip graft and preventing excessive cephalic rotation.



If the tip graft projects more than 3 mm above the domes, lateral crural grafts are used. These grafts are placed over the existing lateral crura and are sutured using 6-0 Monocryl to the lateral cephalic margin of the tip graft. They should be slightly convex and oriented at approximately 45-degree angles from the midline.

Symmetry along the caudal margin of the lateral crural grafts is critical to avoid asymmetry of the nostrils. Lateral crural grafts should be strong enough to prevent excessive cephalic rotation of the tip graft but thin enough to avoid creating bulbosity of the nasal tip.[5] The lateral crural grafts are beveled against the cephalic surface of the tip graft to allow maximal stabilization from behind.

The superior edge of the tip graft can be covered with crushed cartilage and/or perichondrium to help camouflage the graft and create a soft contour. The thick costal cartilage perichondrium is especially useful for tip camouflage, sutured in place using 6-0 Monocryl.

The surgeon should routinely check to be certain that the nasal skin can be closed over the grafts. Intermittently the skin is replaced over the tip structure to help to assess whether closure is possible. This closure needs to be without excessive tension, which can yield tissue necrosis, visible grafts, and tip deformity. Excessive tension on the closure will also lead to increased tip rotation because the tension of the flap will push cephalically on the tip graft.

Once the nasal tip has been stabilized, the nasal lobule can be refined using suturing techniques or tip grafts. When a tip graft is used, it is often camouflaged with lateral crural and buttress grafts. Perichondrium and/or crushed cartilage can be placed over the domes to create a softer look and provide camouflage for grafts.

Dorsal Augmentation

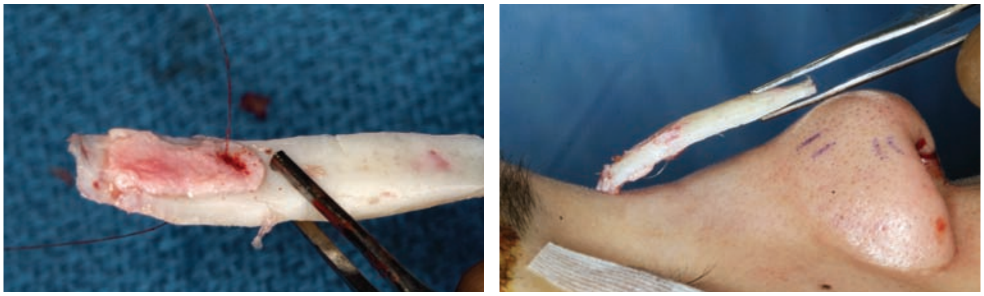
Dorsal augmentation is routinely performed in Asian rhinoplasty. The nasal starting point for the Asian nose is located at or below the midpupillary line, which is lower than that for a white patient.[1] Keeping this in mind, the dorsal height can be set to complement the tip projection.

The dorsal graft can be crafted from auricular and/or septal cartilage. In some cases a septal cartilage graft can be used in combination with an auricular cartilage graft. The auricular cartilage can be used below the septal cartilage to increase the likelihood of a smooth regular graft.

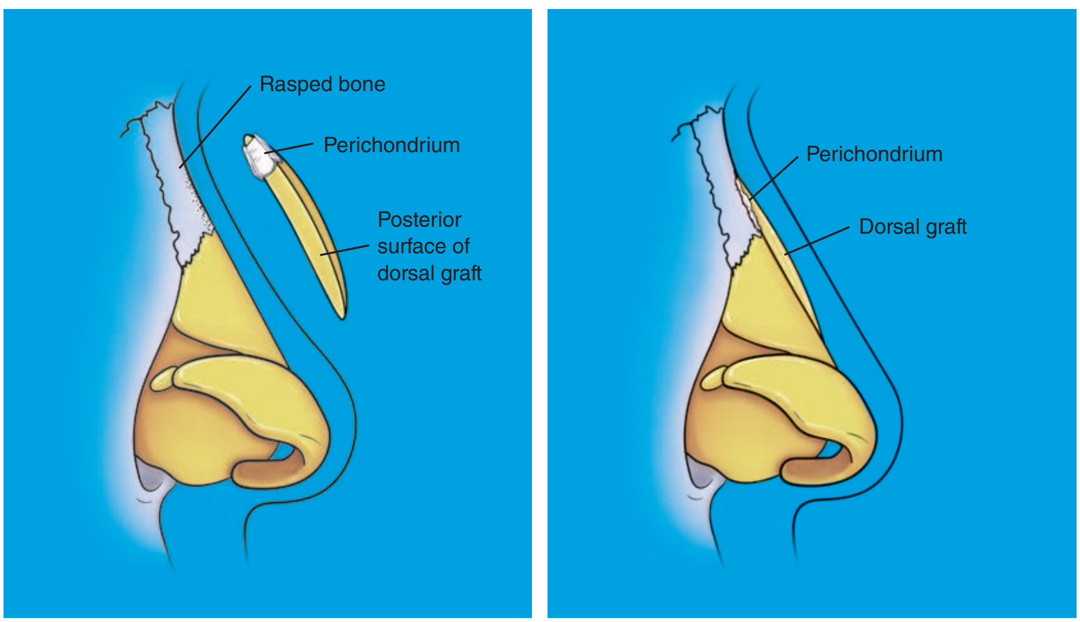
If auricular cartilage is used for the dorsum, the graft can be fashioned into the desired shape and then the edges can be beveled. It is important to carve auricular cartilage carefully to avoid graft visibility.[1] If extra thickness is needed, another piece of auricular cartilage can be sutured to the undersurface of the dorsal graft. The surgeon should keep in mind that auricular cartilage has a tendency to curl at its edges despite fastidious carving. Fortunately Asian skin tends to be thicker, which will help camouflage smaller irregularities.[1] However, over time scar contracture will tend to show these irregularities. Dorsal skin thinned from a previous alloplastic implant will also tend to show the edges of such grafts.

Before placement of the dorsal graft, the base for the graft must be contoured to provide a smooth, natural-appearing transition from the existing dorsum to the graft. This maneuver will require a nasal base that is wider than the graft. If the dorsal graft is wider than the underlying dorsum, an unnatural-appearing dorsal graft will be created, with the potential for visible edges. In most cases osteotomies are not needed in Asian rhinoplasty, because the wider dorsum acts as an ideal base for the dorsal graft. Asian patients who have undergone previous osteotomies may require widening of the bony dorsum and middle vault before placement of the dorsal graft. In these cases, long costal cartilage spreader grafts are positioned to extend between the nasal bones to create width to the bony and middle vault. With the wide base, a large dorsal graft can be beveled to sit on top of the dorsum, creating a well-contoured natural arch over the entire dorsum.

Carving of the dorsal graft from costal cartilage requires both patience and skill. The dorsal graft should be canoe shaped (narrower and thinner at both the superior and inferior ends of the graft; thinner at the cephalic edge). If costal cartilage is used, the graft should be sequentially carved to allow the surgeon to discern and account for any tendency of the graft to curve. Once the curvature is determined, the concave side is placed against the underlying bone and middle vault. With the curvature oriented against the bone and middle vault, the fixation methods will act to counteract any tendency for the dorsal graft to curve.



Fixation of the dorsal graft is accomplished by two methods. First and foremost, the dorsal graft is placed into the tight dorsal subperiosteal pocket. To aid in fixation, perichondrium can be sutured to the undersurface of the superior end of the dorsal graft.[8] Then multiple holes can be made in the bony dorsum using a 2 mm straight osteotome. The bone can also be roughened using a narrow rasp. The rasp may enlarge the pocket over the nasal dorsum and preclude a tight placement. Eight to twelve holes are made in the bony dorsum to expose the cancellous bone and to create a rough healing surface.



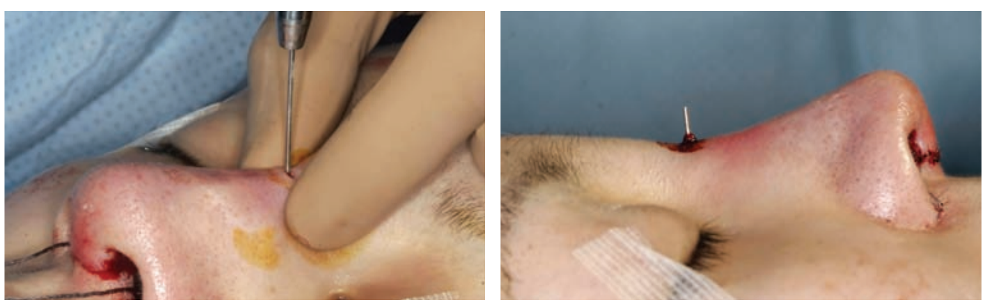
Then the dorsal graft with attached perichondrium is forced into the tight subperiosteal pocket, and the graft becomes immobilized. Soon after surgery the perichondrium will fixate to the holes in the bone. With immobilization of the dorsal graft, the patient does not experience the mobility of an implant on the dorsum; what is more important, the fixation makes deviation or warping of the dorsal graft unlikely. The more rigid the fixation, the less likely any shifting, warping, or deviation can occur.

The dorsal graft is also fixated to the middle nasal vault using two 5-0 PDS sutures placed through the dorsal graft and the upper lateral cartilages. The dorsal graft now has a three-point fixation with superior fixation in the subperiosteal pocket and two points of fixation over the middle nasal vault.

With the concave tendency directed against the bony dorsum, if bending does occur, it will likely create a little more convexity along the superior surface of the graft and may create the slightest dorsal convexity. This can be tolerated by the patient. However, if the dorsal graft is oriented with the convexity against the dorsum, curvature postoperatively could result in fullness in the supratip and radix. This type of deformity would not be well tolerated by the patient.

The nasal dorsum is augmented after the tip projection has been set. In the Asian patient, the nasal starting point should be no higher than the midpupillary line. When costal cartilage is used for augmentation, the graft should be sequentially carved over time to observe and correct any inherent warping of the cartilage.

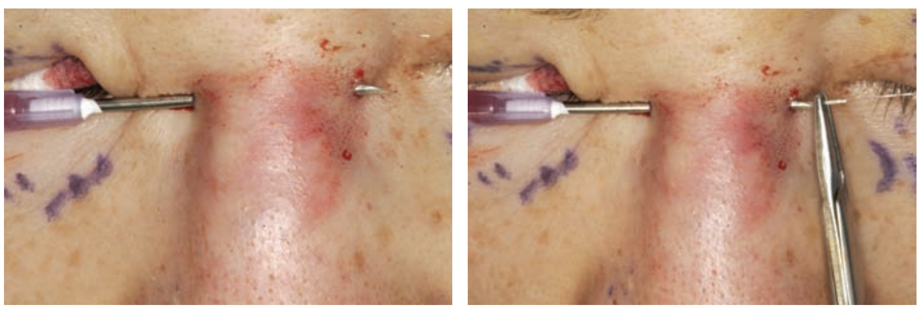
With meticulous techniques and attention to detail, augmentation rhinoplasty for the Asian patient can be successful using autologous materials. The surgeon must always keep in mind the goals and aesthetic ideals of the Asian patient, which often differ from those of the white patient.



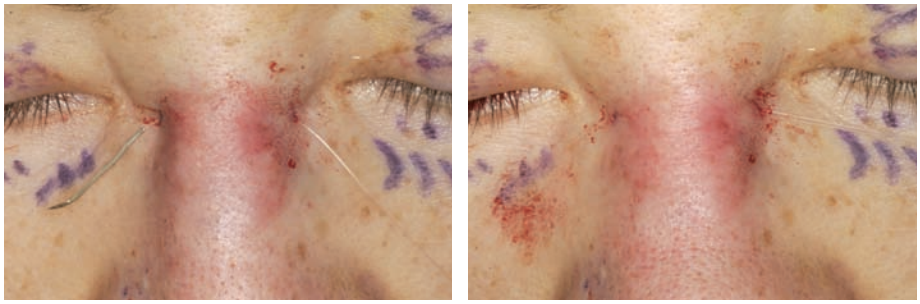
In a patient that had an implant removed, the pocket over the nasal dorsum may be very wide, with no chance of fixation in a tight dorsal pocket. In such a case it is preferable to fixate using one of the following options. After making the holes in the bony dorsum with a 2 mm straight osteotome, the dorsal graft can be fixed

to the bony dorsum using a threaded K-wire. A small 2 mm stab incision is made in the skin above the upper third of the dorsal graft. Then the threaded K-wire is passed through the incision and drilled through the dorsal graft and into the bony dorsum. The K-wire should pass about 3 to 4 mm into the bone. This configuration will force the dorsal graft with its underlying perichondrium onto the holes made in the bone to fixate it into position. On the seventh day after surgery the K-wire can be backed out of the nose in the office, leaving the dorsal graft fixed to the underlying bone.

One of the keys to avoiding deformity from warping of a dorsal graft is to carve the graft, noting the tendency for the graft to curve. If the graft is placed with the concave surface down against the underlying dorsum, it will tend to stay straight, because the forces will be acting against the tendency to curve.



Another option is to drill holes horizontally across the bony nasal vault with a 16-gauge needle that is passed from one side of the dorsum to the other. The 16-gauge needle is passed through small stab incisions made along the sidewalls of the bony dorsum. The holes in the bony dorsum are placed 5 to 8 mm back from the anteriormost projecting line of the dorsum.



Then a 4-0 PDS suture can be passed through the hole in the dorsum and over the top of the dorsal graft. When the suture is cinched down, it will force the dorsal graft with underlying perichondrium against the perforated bony dorsum to allow rigid fixation.

Increasing tip projection in the Asian patient usually results in an increase in tip rotation as well. Many Asian patients cannot tolerate increases in tip rotation. One of the significant drawbacks to the use of implants is that tip rotation will usually increase as tip projection is increased. With structural grafting methods, tip projection and rotation can be precisely controlled with septal extension grafts and tip grafts.

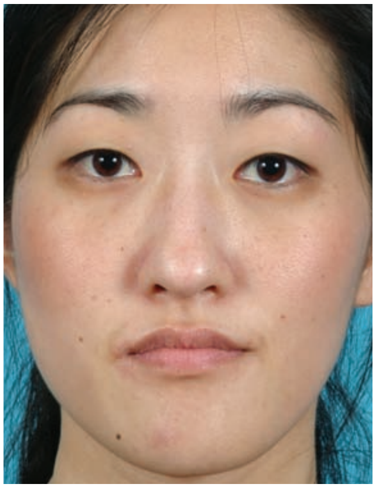
Closing the Nose

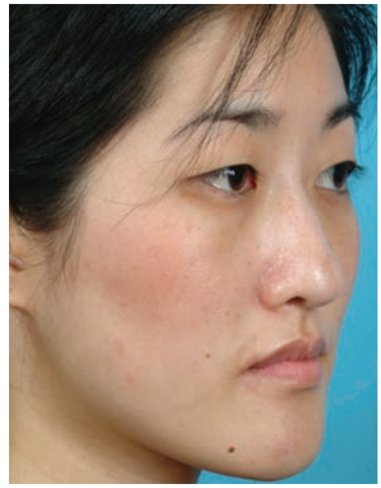
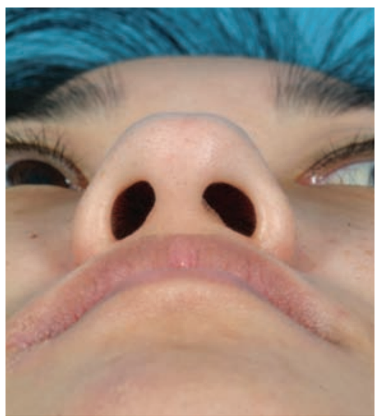
To close the columellar incision, tension is taken off the skin using a midline 6-0 Monocryl subcutaneous suture. The skin is closed with 7-0 nylon vertical mattress and simple sutures. The marginal incisions and septal flap are closed. In some instances, such as when the nose is lengthened and counterrotated, the marginal incisions may require composite auricular grafting to close.

Composite grafts are typically taken from the anterior aspect of the cymba concha and are composed of skin and underlying cartilage. They are carefully sutured into the gap between the vestibular skin and soft tissue triangle skin.

These grafts will allow closure of the infracartilaginous incision near the soft tissue triangle and prevent notching or deformity. A piece of Telfa is placed along the nasal dorsal skin. Steri-Strips are placed, followed by an external cast.

CASE ANALYSES



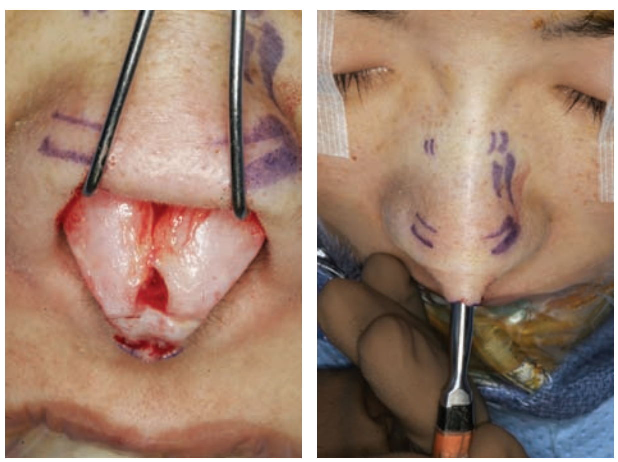
This patient had a dorsal hump and requested correction of her profile and narrowing of her nasal tip. We discussed raising her nasal radix to create a straight profile, because her radix was low.

Nasal analysis revealed the following:

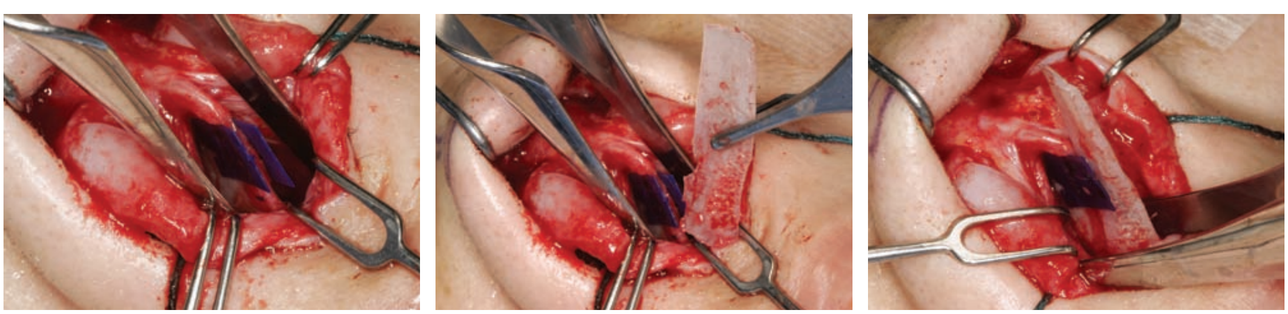
- A wide, bulbous nasal tip
- A low radix that accentuated her dorsal convexity
- An underprojected nasal tip

Surgical Plan

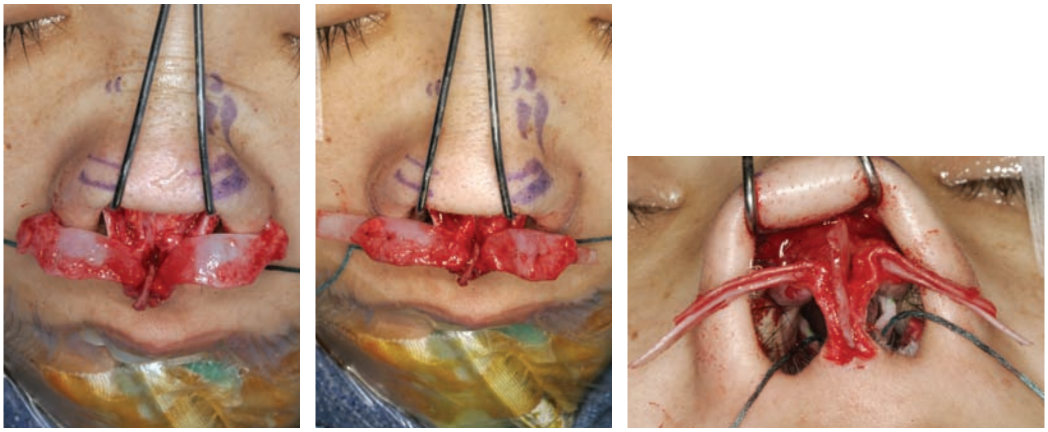
1. Expose the nasal hump through the open approach.
2. Conservatively reduce the nasal hump with a rasp, removing no more than 2 mm.
3. Rasp the sidewalls of the bony dorsum to improve symmetry.
4. Dissect between the medial crura to access the caudal septum.
5. Perform a septoplasty and harvest septal cartilage.
6. Place an end-to-end caudal septal extension graft stabilized with a 0.25 mm perforated PDS plate.
7. Suture the medial crura to the caudal margin of the septal extension graft with 5-0 PDS sutures.
8. Dissect the lateral crura from the underlying vestibular skin.
9. Place lateral crural strut grafts to the undersurface of the lateral crura and suture them with 5-0 PDS sutures.
10. Place 5-0 PDS dome sutures.
11. Place an onlay tip graft over the domes and fixate with 6-0 Monocryl sutures.
12. Place a soft cartilage radix graft covered with a thin layer of fascia.
13. Close the transcolumellar incision.



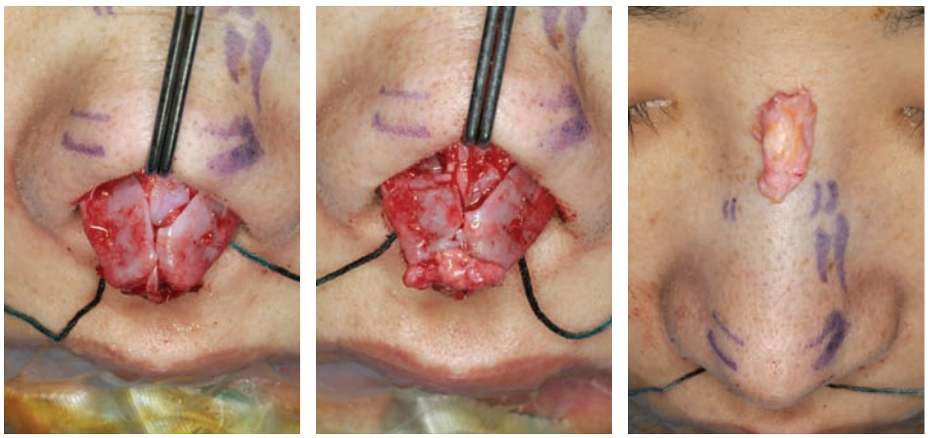
Rasping nasal hump



Placing end-to-end caudal septal extension graft

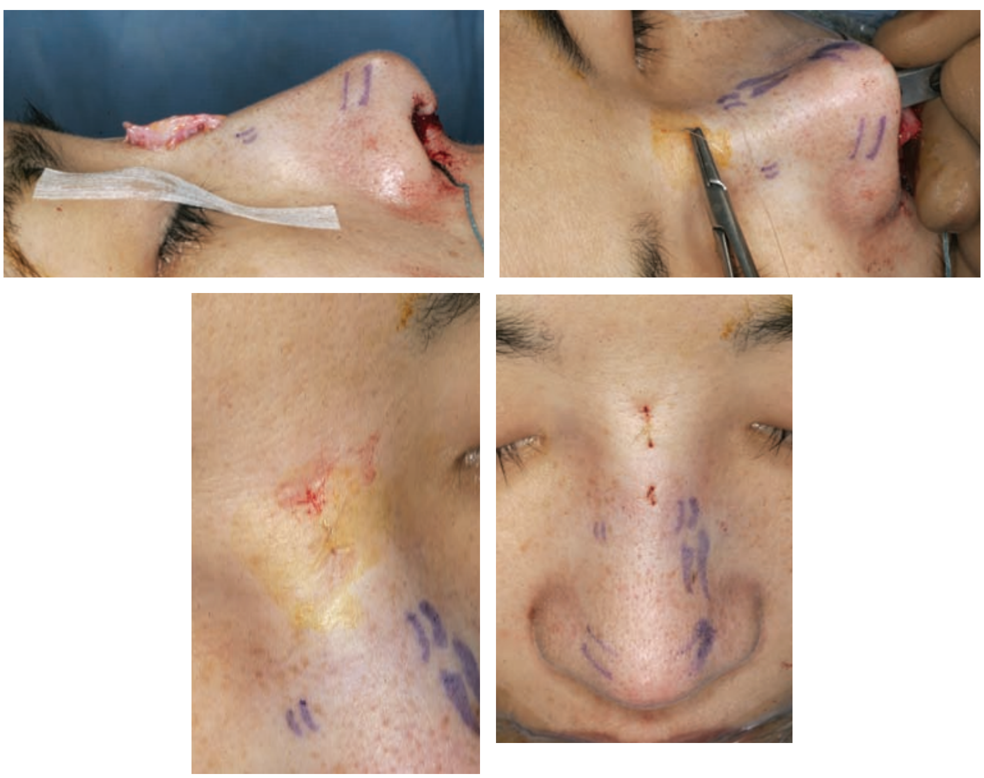


Placing lateral crural strut grafts



Placing onlay grafts

Placing soft cartilage radix graft



Postoperatively, the frontal view shows narrowing of the nasal dorsum and nasal tip with improved symmetry. The lateral view shows a straight dorsum with no dorsal convexity. There is also increased nasal tip projection. On the oblique view, the improved dorsum is evident with no irregularities. Her basal view shows improved nasal tip symmetry and narrowing of the nasal tip.

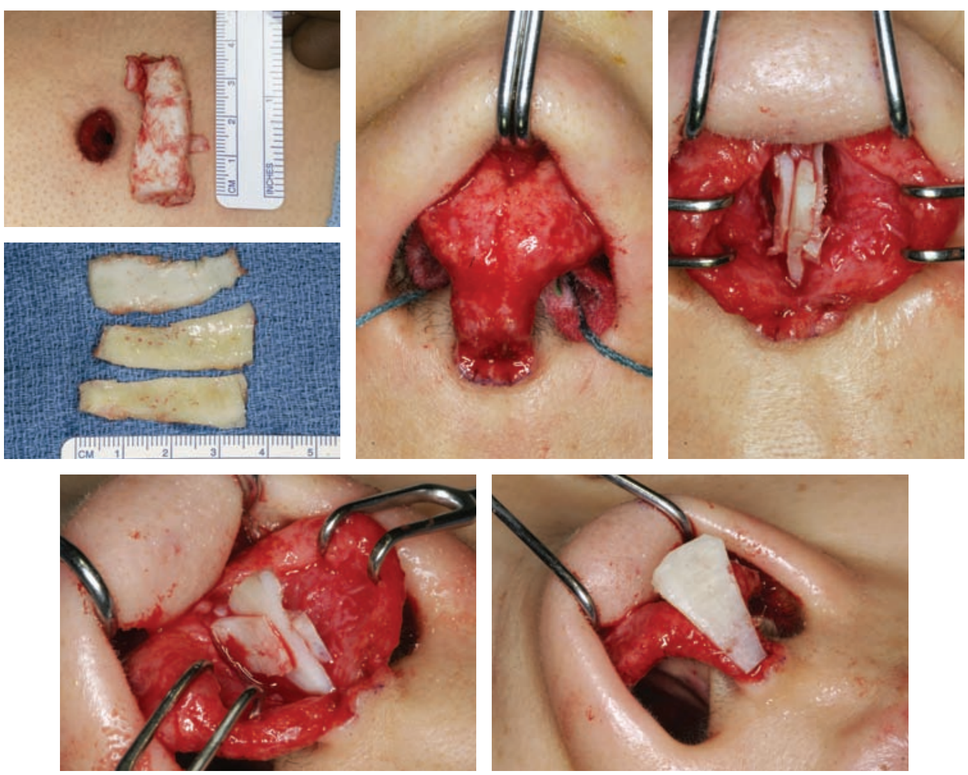
This patient requested augmentation of her nasal dorsum and refinement of her nasal tip. She also had a deficient chin. We discussed harvesting costal cartilage for material to augment her nose and planned a chin augmentation through a submental incision.

Nasal analysis revealed the following:

- A wide nose with a low dorsum
- A poorly defined nasal tip
- An underprojected tip

Surgical Plan

1. Augment the chin through a submental approach.
2. Harvest costal cartilage through an 11 mm chest incision.
3. Expose the dorsum through the open approach.
4. Place submucosal spreader grafts.
5. Fixate an end-to-end caudal septal extension graft to extended spreader grafts.
6. Fixate the medial crura to the septal extension graft.
7. Place a shield tip graft to the tip cartilages and stabilize this with lateral crural grafts.
8. Carve a dorsal graft with suturing of perichondrium to the undersurface of the graft.
9. Create multiple perforations in the bony dorsum with a 2 mm straight osteotome.
10. Place the dorsal graft into the tight dorsal pocket.
11. Fixate the dorsal graft to the middle nasal vault.
12. Camouflage the tip graft with perichondrium and soft tissue.
13. Close the transcolumellar incision.



The patient is seen postoperatively. The frontal view shows improved shadowing along the sidewalls of nose and a narrowed nasal dorsum. The lateral view demonstrates increased dorsal height and increased nasal tip projection. A satisfactory chin augmentation is evident. The oblique view confirms the increase in tip projection and dorsal projection, and the basal view shows the improved triangularity of the nasal base.

POSTOPERATIVE CARE

The patient must take a broad-spectrum antibiotic agent for a minimum of 7 days postoperatively. The patient is instructed to clean the anterior nares and sutures with hydrogen peroxide twice daily, and then apply antibiotic ointment. If a composite graft was used, hydrogen peroxide is avoided; saline solution or sterile water is used instead. The sutures and nasal cast are usually removed on the seventh postoperative day.

Frequent postoperative follow-up permits the surgeon to correct any minor irregularities in the grafts to achieve a better long-term outcome. The nose heals over the patient's lifetime; therefore long-term follow-up is also recommended.

Postoperatively the patient is instructed to consume a low-salt diet, avoid overheating, and keep his or her head elevated. These measures help to reduce postoperative edema. We do not recommend resumption of vigorous exercise until at least 1 month postoperatively. When the patient resumes physical activities, he or she should begin slowly and increase the intensity gradually.

Postoperative edema is expected in cases in which there was extensive tissue dissection (for example, removal of alloplastic implants) or when perichondrium was used. The patient should be reassured that this is a normal and expected postoperative finding and that edema should start to subside approximately 6 weeks after surgery. In cases of persistent supratip edema, the patient may be instructed to tape the supratip region at night, or a steroid (triamcinolone acetonide 10 mg/ml) may be injected subdermally. The steroid injection should be low volume (0.1 to 0.4 ml) and deep to the dermis to reduce the risk of supratip atrophy.

Preoperatively, we discuss with each patient the fact that the nose will heal over a long period of time: approximately 40% healed at 1 year and 50% at 2 years, with the rest of the healing occurring over the patient's lifetime. We continue to follow the patient closely in the first year after surgery (up to 12 times in the first year). Moreover, we strongly encourage annual follow-up visits for an indefinite period. Close monitoring of the augmentation rhinoplasty patient allows the surgeon to attempt to correct any irregularities that may arise.

COMPLICATIONS

Possible complications after rhinoplasty include those related to harvesting the cartilage for grafting and those associated with augmentation rhinoplasty. The risks associated with auricular cartilage harvest include pain, keloid formation,

visible scarring, bleeding, necrosis of conchal bowl skin, and auricular deformity. We have found that harvesting of the auricular cartilage using a posterior approach helps to reduce the risks of visible scarring and deformity.

The harvesting of costal cartilage is associated with the following risks: infection (including pneumonia), postoperative pain at the harvest site, rib cage deformity, hypertrophic scarring, bleeding, breast implant damage or rupture (if an implant is present), and pneumothorax. Pneumothorax is rare and should not occur if the perichondrium is left intact on the undersurface of the costal cartilage. Meticulous dissection and closure help to reduce these potential complications.

Possible complications associated with augmentation rhinoplasty include bleeding, infection, visible grafts, and warping or displacement of the grafts. Sequential carving of the grafts with placement of the concave surface against the bony dorsum is strongly recommended to help reduce the incidence of deformity. Careful execution of the augmentation rhinoplasty and close follow-up also help reduce the incidence of long-term complications.

The key to preventing warping of the dorsal graft is to maximize fixation of the dorsal graft to the bony dorsum. This can be accomplished by suturing perichondrium to the undersurface of the dorsal graft. The perichondrium can fixate to the bony dorsum after making perforations in the bony dorsum with a 2 mm straight osteotome. If the dorsal graft is placed into the tight dorsal pocket, the graft, with underlying perichondrium, will fix to the bone and limit movement.

CONCLUSION

Asian rhinoplasty primarily involves augmentation of the nasal dorsum and improvement of the nasal tip lobule using a variety of suturing and grafting techniques. Successful rhinoplasty in the Asian patient is dependent on adherence to a structural approach to rhinoplasty and being mindful of the aesthetic goals of the Asian patient.

The grafting techniques described here are well tolerated, and patients who undergo costal cartilage harvesting for augmentation are discharged home on the day of surgery. With careful carving of the costal cartilage and meticulous technique, the incidence of warping can be minimized. However, if the surgeon is not able to or interested in taking the time to execute the harvest, carving, and grafting of costal cartilage, other materials should be considered, such as auricular or septal cartilage or alloplastic implants. A subset of Asian patients need only

minor augmentation and stabilization. For these cases, the use of auricular and/or septal cartilage is a reasonable choice.

The ability to augment the Asian nose within the aesthetic ideals of the patient can provide the rhinoplasty surgeon with a great deal of satisfaction. To be successful, the surgeon must have a thorough understanding of the patient's goals and be able to reach these goals using sound structural grafting techniques.

KEY POINTS

- Rhinoplasty in an Asian patient requires attention to a unique set of aesthetic goals that differs from the goals for a white patient. The current ideal has shifted toward a more natural and refined look. Computer imaging is very important in this patient population to communicate proposed changes.
- The Asian nose often has deficient structural support of the nasal tip and dorsum, which must be augmented to achieve the desired refinement. A structural approach to Asian rhinoplasty allows the surgeon to accomplish these goals.
- The options for materials for augmentation should be discussed with the patient. The pros and cons of using alloplastic implants versus autologous materials can be explained to the patient so that he or she can then make an educated decision.
- Although alloplastic implants have been widely used in Asian rhinoplasty, the current trend is away from the use of such materials. Autologous cartilage for grafting—harvested from the septum, auricle, and rib—is being used more frequently in the Asian nose. Alloplastic implants are being used less frequently in the mobile lower third of the nose.
- If the surgeon is concerned about controlling tip rotation as tip projection is increased, dissection between the medial crura allows eventual placement of a caudal septal extension graft to stabilize the tip and prevent excessive tip rotation.
- The nasal tip must often be augmented to provide increased support using a variety of grafting techniques including the columellar strut graft, the caudal septal extension graft, and the extended columellar strut graft.
- Once the nasal tip has been stabilized, the nasal lobule can be refined using suturing techniques or tip grafts. When a tip graft is used, it is often camouflaged with lateral crural and buttress grafts. Perichondrium and/or crushed cartilage can be placed over the domes to create a softer look and provide camouflage for grafts.
- The nasal dorsum is augmented after the tip projection has been set. In the Asian patient, the nasal starting point should be no higher than the midpupillary line. When costal cartilage is used for augmentation, the graft should be sequentially carved over time to observe and correct any inherent warping of the cartilage.

- One of the keys to avoiding deformity from warping of a dorsal graft is to carve the graft, noting the tendency for the graft to curve. If the graft is placed with the concave surface down against the underlying dorsum, it will tend to stay straight, because the forces will be acting against the tendency to curve.
- Increasing tip projection in the Asian patient usually results in an increase in tip rotation as well. Many Asian patients cannot tolerate increases in tip rotation. One of the significant drawbacks to the use of implants is that tip rotation will usually increase as tip projection is increased. With structural grafting methods, tip projection and rotation can be precisely controlled with septal extension grafts and tip grafts.
- Frequent postoperative follow-up permits the surgeon to correct any minor irregularities in the grafts to achieve a better long-term outcome. The nose heals over the patient's lifetime; therefore long-term follow-up is also recommended.
- The key to preventing warping of the dorsal graft is to maximize fixation of the dorsal graft to the bony dorsum. This can be accomplished by suturing perichondrium to the undersurface of the dorsal graft. The perichondrium can fixate to the bony dorsum after making perforations in the bony dorsum with a 2 mm straight osteotome. If the dorsal graft is placed into the tight dorsal pocket, the graft, with underlying perichondrium, will fix to the bone and limit movement.

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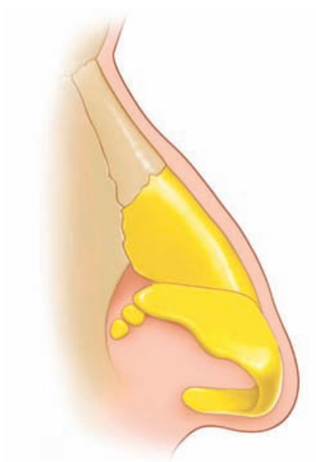
The Aging Nose

Rod J. Rohrich ▪ Jeffrey E. Janis ▪ Jamil Ahmad ▪ Jack P. Gunter



Rhinoplasty in aging patients poses a unique set of challenges to plastic surgeons, because these patients have different expectations and motivations than younger patients do.[1] Often, consultation is sought because of major life stressors. Open and frank communication between the surgeon and patient is essential in defining realistic goals and expectations. Anatomic changes in skin quality, cartilage characteristics, underlying bony framework, and the nasal airways require special consideration to optimize aesthetic and functional results.[2]

ANATOMY OF THE AGING NOSE

Changes in Aesthetic Facial Proportion

Rhinoplasty in older patients differs from rhinoplasty in younger patients in many aspects. These differences must be understood before beginning a surgical procedure.

Aging patients have relative shortening of the lower third of the face (between the nasal base and menton). This results from muscle atrophy of the orbicularis oris, fatty tissue absorption, and alveolar, maxillary, and mandibular resorption, which are sequelae of the edentulous state of many patients.[2-6] The result of this shortening is a concomitant lengthening of the upper and middle thirds, including a relative lengthening of the nose, which gives the appearance of a drooping tip and accentuates dorsal convexity.

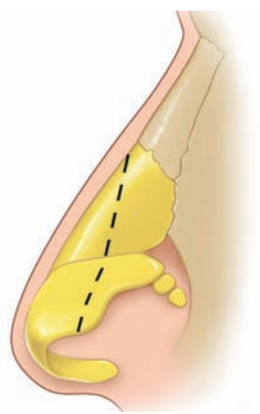
Skin Quality

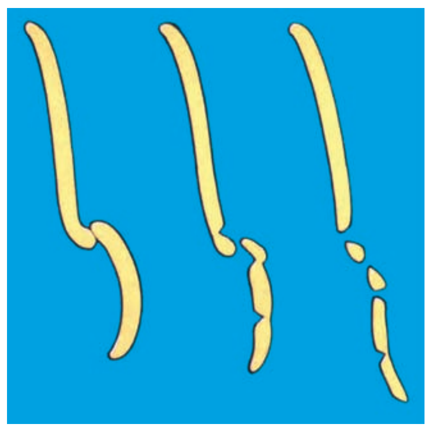
The skin quality of the face and nose changes with advancing age.[7] Intrinsic changes on a cellular level, combined with prolonged sun exposure, result in diminished skin elasticity and actinic changes.[3] Microscopically the dermis be-

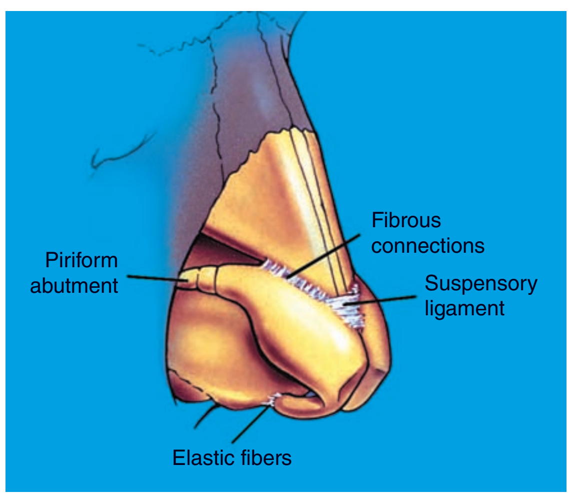
comes thinner with decreased dermal collagen and an increase in disorganized fibrillin and elastin.[8-11] Decreased skin elasticity and generalized skin redundancy necessitate wider nasal skin undermining and more significant underlying structural alteration to effect a noticeable aesthetic result.[1]

Often the alae and tip take on a fuller, more unnatural appearance as a result of an increased density of sebaceous glands, potentially leading to rhinophyma. In severe cases external valve obstruction can result from a mass effect.[12,13] This can be especially prominent in men. External incisions in the areas of thickening can cause prominent scarring. However, incisions in areas with thinner skin, such as the columella and dorsum, generally heal with minimal scarring.

The Nasal Tip Complex







The nasal tip undergoes the most consistent and significant changes in aging patients, which in turn affects the rest of the nasal aesthetics.[2,14,15] Therefore it usually is the area that requires the most refinement. Specifically the tip appears to droop and elongate.

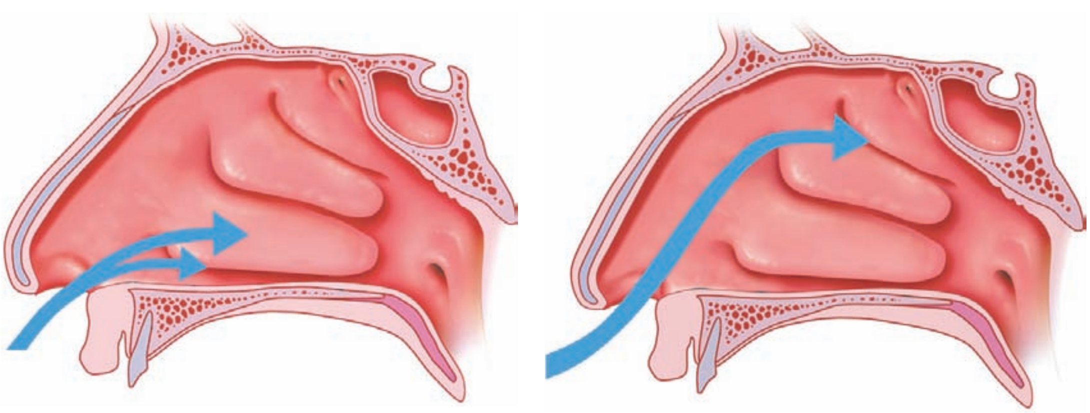
The underlying structural cause is multifactorial[3,5,16,17]:

- Attenuation, fragmentation, and potential ossification of the fibroelastic attachments between the upper and lower lateral cartilages (the scroll area) result in downward migration of the lateral crura.
- Weakening or loss of suspensory ligament support destroys medial crural support.
- Thickening and possible ossification of the cartilages enhances prominence.
- Thickening of the overlying skin and subcutaneous tissue with concomitant increased vascularity augments bulkiness and weight of the tip.
- Maxillary alveolar hypoplasia causes divergence of the medial crural feet and columellar shortening.

The sum of these factors is downward rotation of the lobule, which creates an acute columellar-lobular angle and shortens the vertical dimension of the lower third of the face.[6,18] The aesthetic result is a relatively longer nasal length and the appearance of a droopy tip.

Loss of support of the lower lateral cartilages results in a drooping nasal tip complex with an apparent increase in nasal length.

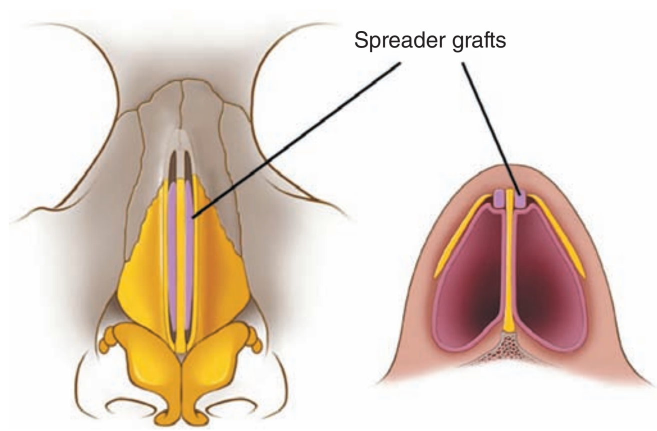
The Nasal Airway



Although the usual causes of functional airway obstruction, namely, septal abnormalities and inferior turbinate hypertrophy, can be seen in this age group, other anatomic changes associated with advanced age can also produce obstructive symptoms.[2,19-23] A drooping nasal tip complex redistributes air flow more

superiorly within the vestibule, which can result in obstructive symptoms.[1,2,5,24] Downward migration and atrophy of the nasal musculature can cause the upper and lower lateral cartilages to separate, causing internal nasal valve collapse on maximal inspiration. To restore proper airway flow dynamics, the tip must be cephalically rotated. Furthermore, dorsal spreader grafts can be used, if needed, to correct collapsed internal nasal valves.[25,26]

Nasal tip descent and internal nasal valve collapse can result in obstructive airway symptoms, which are corrected by rotation of the tip and placement of spreader grafts.



The ability of the nose to warm and humidify inspired air may be compromised, because mucosal gland atrophy is common as patients age. The mucoperichondrium abutting the septum becomes thin and fragile, making it more difficult to cleanly dissect without perforation. Furthermore, bleeding can be a problem, not only because of increased vessel fragility, but also because frequently these patients have underlying hypertension, which needs to be controlled perioperatively. Therefore, rather than raise mucosal flaps, inferior turbinate reduction is best performed extramucosally to minimize postoperative bleeding.[27]

Descent of the tip and loss of support in the internal nasal valve region may result in nasal obstructive symptoms that should be treated at the time of rhinoplasty.

The Bony Vault

With age, differential remodeling of the midface causes midface retrusion and posterior displacement of the piriform aperture.[28] Because the piriform aperture serves as the foundation for the nasal pyramid, posterior displacement of this structure leads to a retruded nasal profile. The alar base–columellar relationship can be affected by the loss of piriform height. These changes must be considered when facial proportions are analyzed for rhinoplasty.

The bony nasal pyramid itself becomes more brittle and fragile because of natural processes in aging, making osteotomies more prone to comminution and outcomes more unpredictable.[29] Therefore osteotomies are not recommended in the aging nose. Required osteotomies should be performed in low-to-low fashion with a percutaneous perforated technique,[30] and they should be complete rather than greenstick for a more regular break.

The nasal bony pyramid in older patients is thinner and more brittle; consequently, osteotomies should be avoided if at all possible.

The Dorsum

A prominent dorsal hump that is characteristic of the aging nose may be a relative finding because of a drooping nasal tip. Therefore, before a dorsal hump is reduced, the tip should be corrected to decrease the likelihood of an open roof deformity from overresection of the dorsum. Because an open roof deformity is typically treated by an osteotomy, which is not recommended in aging patients, a suboptimal result is likely.

The nasal tip position should be corrected before the dorsal hump is reduced to prevent overresection.

If intrinsic dorsal aesthetic deformities persist after tip complex modification, an open approach with component dorsal reduction can be performed.[31] Extramucosal hump excision/reduction is useful to prevent internal nasal valve dysfunction and preserves a closed space for the placement of dorsal or spreader grafts.

Component dorsal hump reduction helps to prevent inadvertent damage to the internal valves, with the creation of submucous tunnels and sharp release of the upper lateral cartilages from the septum. This technique helps to prevent injury to the cartilage and/or mucoperichondrium.

Because the dorsal skin is thinner in aging patients, underlying dorsal irregularities are more evident. These can be camouflaged if necessary by morselized onlay septal cartilage grafts. Alternatively, temporalis fascia grafts, conchal cartilage grafts, or allografts can be placed.

INDICATIONS AND CONTRAINDICATIONS

Although younger patients frequently have clearer and more explicit reasons for rhinoplasty, the motivation of older patients can be somewhat vague and requires careful consideration. The creation of a dramatic change is often implausible in an aging patient's nose; therefore unrealistic desires need to be tempered with realistic expectations. Appropriate motivational factors include a long-standing desire for change, midlife career change, worsening airway obstruction, previous failed rhinoplasty, or the desire to enhance economic potential. However, significant life stressors such as divorce or a death in the family are common in this age group. The history should clarify such events, and in some cases rhinoplasty should be deferred until the patient is more stable psychologically.[32,33]

The motivation of older patients seeking rhinoplasty must be carefully evaluated to screen for significant life stressors such as death of a loved one or divorce.

These patients frequently have more comorbidities relative to their younger counterparts. Proper time and attention must be paid to obtaining a thorough medical history, including assessment for hypertension, diabetes, coronary artery disease, and current medications. Next, a specific nasal history is obtained, including nasal trauma, allergies, sinus problems, and prior nasal surgery.

Comorbidities are optimized preoperatively, and medications that may promote bleeding such as aspirin, nonsteroidal antiinflammatory drugs, some herbal medications, and anticoagulants (for example, coumadin) are discontinued before surgery.

PREOPERATIVE ASSESSMENT AND PLANNING

A thorough examination requires assessment of the nose within the context of facial harmony. This involves evaluation of facial features, including malar flattening, mandibular remodeling/resorption, and microgenia. A standard nasal examination is performed, with careful attention to the presence of typical stigmata of the aging nose, specifically a relative dorsal hump, drooping nasal tip, sebaceous gland hyperplasia or rhinophyma, separation of the medial crural footplates, columellar shortening, and internal/external valve compromise. Maneuvers such as repositioning of the tip more cephalically or a Cottle test may correct the underlying nasal airway obstruction.

The intranasal examination is performed after the mucosa is shrunk with oxymetolazone spray. Special attention is paid to possible septal deviation, inferior turbinate hypertrophy, the internal nasal valves, and the mucosa itself.

Standardized digital photographs are obtained, and computer imaging is used. The role of computer imaging is invaluable in this subpopulation because of its ability to help patients to visualize the often subtle changes of aging, and to help better educate patients on realistic changes that can be expected.

At a second preoperative consultation, expectations and computer images are reviewed, questions answered, and an appropriate surgical plan developed.

OPERATIVE TECHNIQUE

Although the operative plan is tailored for each patient, the following common goals apply to rhinoplasty in the aging nose[2]:

- Increase tip rotation with tip refinement.
- Increase tip projection and relative columellar lengthening.
- Decrease the overall nasal length.
- Correct the dorsal hump.
- Address and support the internal nasal valves.
- Correct septal deviation and inferior turbinate hypertrophy.

Operative techniques for correction of nasal deformities in older patients should emphasize upward tip rotation, conservative dorsal hump reduction, and avoidance of nasal osteotomies.

The following operative tenets are followed to achieve these endpoints:

- Wide skin undermining offsets decreased skin elasticity and redundancy.
- Tip-suturing techniques (medial crural, interdomal, and transdomal) are preferred over more destructive methods for alteration of the nasal tip.
- Dorsal hump removal should be conservative (and performed after the tip has been initially corrected) to prevent overresection.
- Proper nasofacial proportions need to be restored.
- Autologous septal grafts (columellar strut or dorsal spreader) are used if needed. These should be harvested with care because mucoperichondrium is thin.
- Cephalic trimming is conservative. A strip of at least 6 mm should remain.
- Osteotomies should be used only if absolutely necessary.
- Extramucosal inferior turbinate resection helps to minimize bleeding.

Nasal tip descent accentuates preexisting dorsal deformities.

Our preferred operative sequence is similar to that used in primary rhinoplasty:

- Give a general anesthetic.
- Infiltrate with local anesthetic.
- Make a transcolumellar stair-step incision for an open approach.
- Harvest and reconstruct the septum.
- Resect/outfracture the inferior turbinate.
- Adjust the tip with suture techniques (increase rotation/increase projection).
- Reduce the dorsal hump, and place an onlay graft if needed.
- Refine the tip.
- Perform controlled percutaneous osteotomies if necessary.
- Close the incision.
- Place internal and external nasal splints.

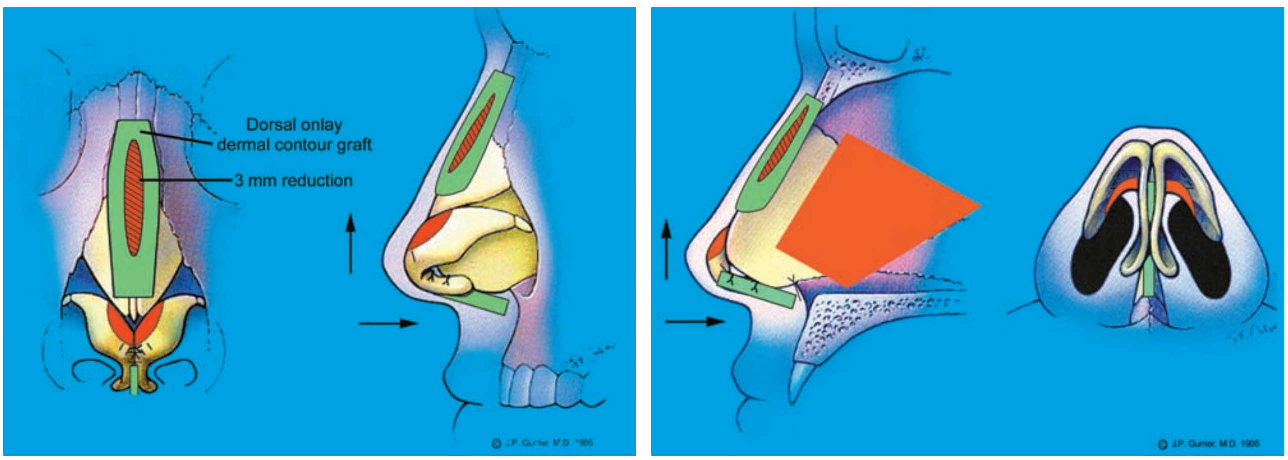
CASE ANALYSES

This 54-year-old man presented with a drooping nasal tip, a dorsal hump, and nasal airway obstruction (greater on the right than the left) that had progressed for 5 years. He desired concomitant rhytidectomy. Nasal analysis demonstrated thick sebaceous nasal skin, a nasolabial angle of less than 85 degrees, a normal radix position, adequate tip projection with a drooping tip, a dorsal hump with increased nasal length, a narrow midvault area, right caudal septal deviation, and left posterior septal deviation and compensatory right inferior turbinate hypertrophy.

Changes in the nasal skin with age result in a loss of elasticity and do not allow the skin to redrape over the altered nasal framework as well as in younger patients.

The operative goals were as follows:

- Define and rotate the tip upward.
- Reduce nasal length.
- Reduce the dorsal hump.
- Increase the nasolabial angle to 90 degrees.
- Reconstruct the septum with a swinging-door flap to correct caudal septal deviation.
- Perform bilateral, anteroinferior submucosal turbinate resection (greater on the right than on the left).
- Do not perform osteotomies.



Surgical Plan

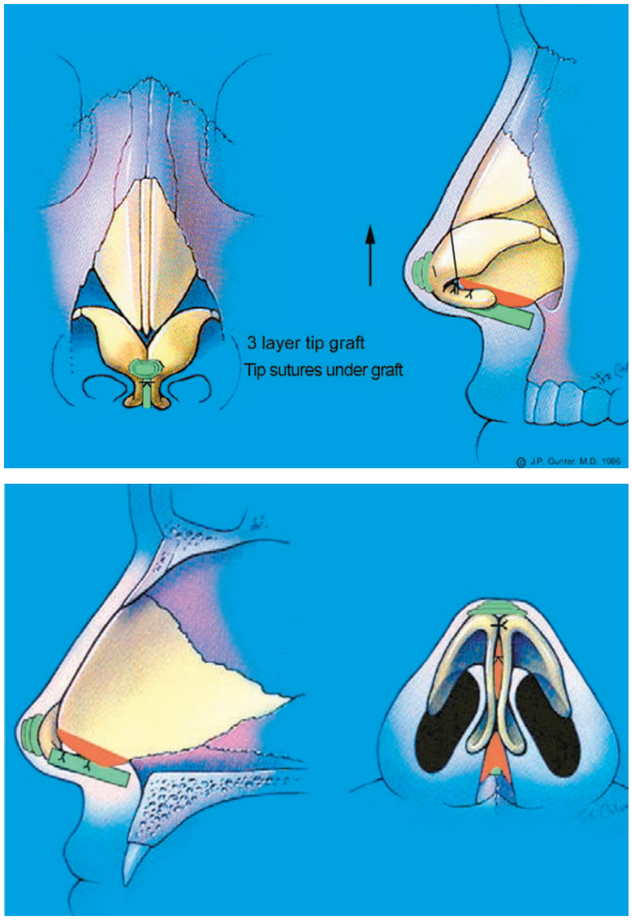
1. Perform open rhinoplasty through a transcolumellar stair-step incision.
2. Make a left hemitransfixion incision for septal dissection and correction of the caudal deviation with a swinging-door septal flap and a 5-0 PDS suture to secure the caudal septum to the nasal spine.
3. Perform bilateral, submucosal inferior turbinate resection anteriorly.
4. Perform cephalic trim of lower lateral cartilages.
5. Define the tip with medial crural, interdomal, and transdomal sutures of 5-0 PDS.
6. Place a columellar strut and medial crural–septal spanning sutures to rotate the tip and increase the nasolabial angle.
7. Reduce the hump incrementally (3 mm).
8. Place a dorsal onlay contour dermal graft.

The patient is shown 15 months after rhinoplasty and rhytidectomy. His nasofacial balance, dorsal hump correction, and tip rotation are well maintained.

This 71-year-old woman had a history of cleft lip and palate and two rhinoplasties. She presented with a plunging nasal tip and a dorsal hump.[2] Nasal analysis confirmed a relative dorsal hump with increased nasal length, a severe plunging nasal tip, a nasolabial angle of less than 85 degrees, and left alar base collapse consistent with a history of cleft lip.

The operative goals were as follows:

- Rotate the tip upward.
- Refine the tip.
- Shorten the nose simultaneously.
- Increase the nasolabial angle to 90 degrees.
- Do not perform osteotomies.



Surgical Plan

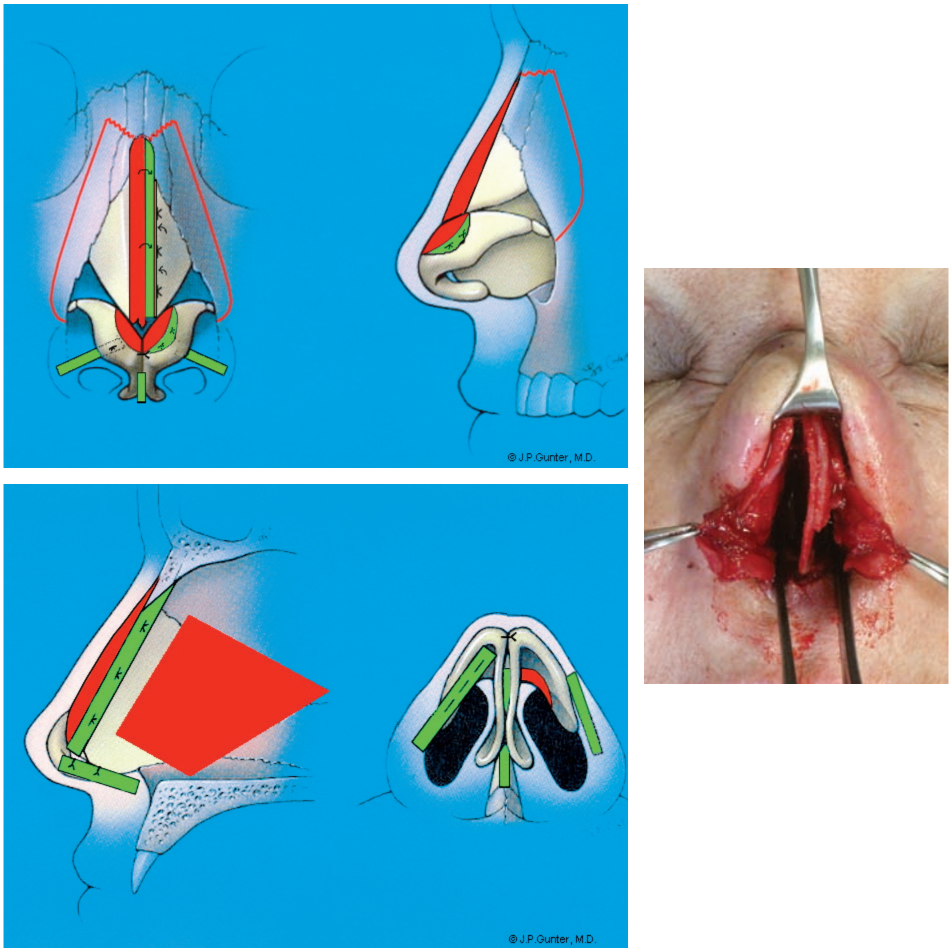
1. Perform an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Resect old scar tissue.
3. Place a columellar strut with a medial crural–septal spanning suture to rotate the tip and increase the nasolabial angle to 90 degrees.
4. Place interdomal and transdomal sutures to refine the tip.
5. Place a three-layer infratip lobular septal cartilage graft to increase projection and increase tip definition.
6. Resect 3 mm of the caudal septum.
7. Do not perform osteotomies.

The patient is shown 27 months postoperatively. Her drooping tip, dorsal hump, and nasolabial angle are corrected, although alar base asymmetry persists.[2]

This 61-year-old woman had a septorhinoplasty 20 years previously, and significant dental surgery over the 5 years preceding her presentation. She desired revision rhinoplasty with septal reconstruction. She had a dorsal hump, tip asymmetry, and severe bilateral nasal airway obstruction. Nasal analysis confirmed a relative dorsal hump with asymmetrical dorsal aesthetic lines, tip asymmetry, caudal septal deviation, and right alar collapse. In addition, she had septal deviation, right external valve collapse, and left internal valve collapse.

The operative goals were as follows:

- Reduce the dorsal hump with a left dorsal spreader flap.
- Restore dorsal aesthetic lines.
- Reconstruct the septum with correction of caudal septal deviation.
- Refine the tip.
- Correct the right alar collapse with an extended alar contour graft.



Surgical Plan

1. Perform an open approach with a stair-step transcolumellar incision and bilateral infracartilaginous extensions.
2. Perform component dorsal hump reduction (3 mm), and create a left dorsal spreader flap for left internal valve reconstruction.
3. Reconstruct the septum with harvest of the remaining cartilaginous and bony septum.
4. Graft septal bone to straighten and buttress the L-strut.
5. Place a columellar strut with medial crural–columellar strut sutures to unify the tip complex.
6. Place interdomal and transdomal sutures to refine the tip.
7. Place a right extended alar contour graft.
8. Place a left alar contour graft.
9. Perform percutaneous perforated lateral osteotomies.

The patient is shown 14 months postoperatively. Her dorsal hump is removed, left internal valve restored, tip refined, caudal septal deviation straightened, and right alar collapse corrected. Her nasal airflow is normal bilaterally.

KEY POINTS

- Loss of support of the lower lateral cartilages results in a drooping nasal tip complex with an apparent increase in nasal length.
- Nasal tip descent and internal nasal valve collapse can result in obstructive airway symptoms, which are corrected by rotation of the tip and placement of spreader grafts.
- Descent of the tip and loss of support in the internal nasal valve region may result in nasal obstructive symptoms that should be treated at the time of rhinoplasty.
- The nasal bony pyramid in older patients is thinner and more brittle; consequently, osteotomies should be avoided if at all possible.
- The nasal tip position should be corrected before the dorsal hump is reduced to prevent overresection.
- The motivation of older patients seeking rhinoplasty must be carefully evaluated to screen for significant life stressors such as death of a loved one or divorce.
- Operative techniques for correction of nasal deformities in older patients should emphasize upward tip rotation, conservative dorsal hump reduction, and avoidance of nasal osteotomies.
- Nasal tip descent accentuates preexisting dorsal deformities.
- Changes in the nasal skin with age result in a loss of elasticity and do not allow the skin to redrape over the altered nasal framework as well as in younger patients.

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The Male Nose

Rod J. Rohrich ▪ Jeffrey E. Janis ▪ Jack P. Gunter

Rhinoplasty in general tends to be performed with greater caution in male patients. Men typically have relatively nonspecific complaints, are usually more demanding, and are much less attentive than women during the consultation. It is essential for surgeons that male patients have realistic goals before undergoing surgery. In addition, the surgeon must confirm that the male patient has in fact listened to and understood all of the risks, benefits, and options regarding the procedure.

It is crucial to recognize specific characteristics that are unique to male rhinoplasty patients. Careful treatment is needed to preserve masculine features and prevent overfeminization.[1,2] Excessive dorsal reduction and/or tip refinement produces unsatisfactory results. This chapter will focus on proper evaluation, surgical planning, and intraoperative techniques that will produce a balanced, harmonious nose in relation to the rest of a man's face.

PREOPERATIVE EVALUATION

Initial Consultation

As with all patients desiring plastic surgery, it is critical to preoperatively identify those who have potentially unrealistic expectations. Gunter[1,2] has described 13 danger signs that may indicate the patient has underlying psychological issues. Gorney[3] uses the following acronym to describe potential problem patients: **s**ingle **i**mmature **m**ale **o**verly expectant **n**arcissistic (SIMON).

This chapter is adapted from Rohrich RJ, Janis JE, Kenkel JM. Male rhinoplasty. Plast Reconstr Surg 112:1071-1085, 2003.

Red Flags When Assessing Patients Suitability for Rhinoplasty

1. Minimum disfigurement
2. Delusional distortion of the body image
3. An identity problem or sexual ambivalence
4. Confused or vague motives for wanting the surgery
5. Unrealistic expectations of change in life situations as a result of the surgery
6. A history of poorly established social and emotional relationships
7. Unresolved grief or a crisis situation
8. Present misfortunes blamed on physical appearance
9. Older neurotic man overly concerned about aging
10. A sudden anatomic dislike, especially in older men
11. A hostile, blaming attitude toward authority
12. A history of seeing physicians and being dissatisfied with them
13. The indication of paranoid thoughts

Certain danger signs suggest that a patient may have an underlying psychiatric disturbance.

Compared with female patients, males generally tend to have a poorer understanding of their deformities and have greater difficulty describing the specific changes they desire.[1,2,4] This, combined with a tendency toward selective hearing in men, makes it even more critical to elicit the patient's goals and determine whether they are realistic during the initial consultation. A second follow-up consultation is highly recommended to reassess the patient's desires, develop a realistic operative plan, and reaffirm his understanding of the anticipated procedure.

A standardized combination of anterior, lateral, oblique, and basal photographs, combined with computer imaging, is vital to the preoperative surgical plan. Computer imaging allows patients to visualize potential realistic outcomes, which in turn helps to alleviate anxiety.[5] It also verifies the importance of the concept of facial harmony and helps patients to become active participants in determining

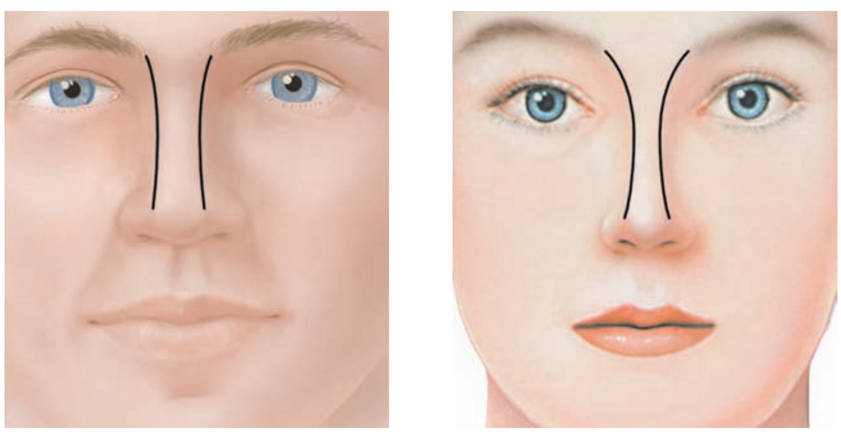
the surgical goals and final outcome. This tool is especially important in male rhinoplasty patients. However, it must be stressed in discussions with the patient that computer images do not imply or guarantee surgical results. They are an educational tool only, and each patient must sign an informed consent to this effect.

Facial Analysis

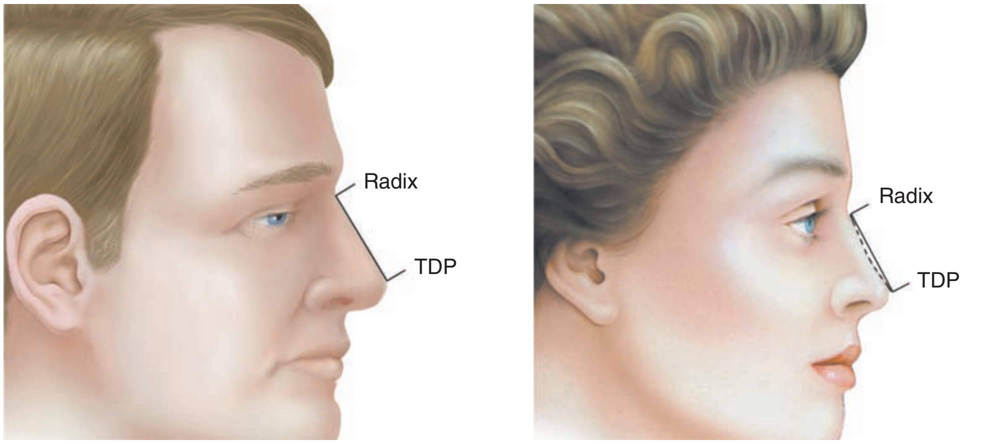
A systematic and meticulous analysis of the face is crucial to diagnose the problem and determine the best course of action. Proportions and relationships of facial structures of an aesthetically pleasing face have been established; these are reviewed in detail in Chapter 6. Some of the differences between male and female patients will be highlighted in this chapter.[2,5-7]

Proper facial analysis is crucial to ensure appropriate facial harmony and balance.

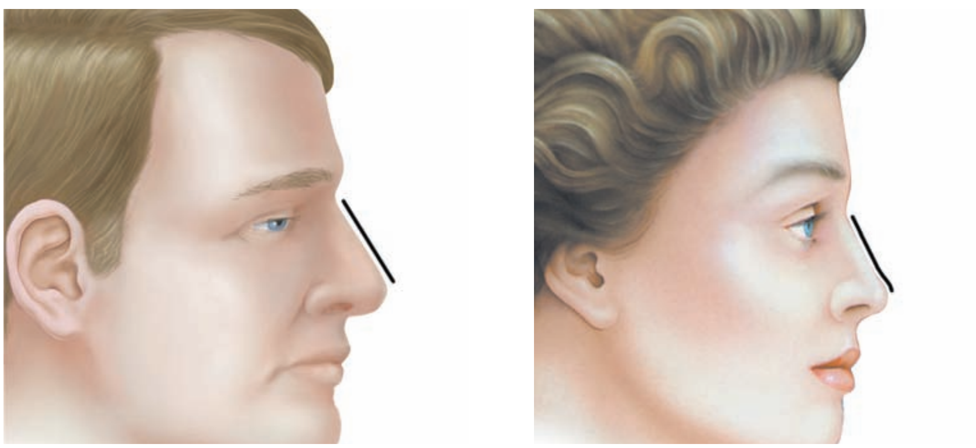
In general, male faces tend to be heavier, more square, and more pronounced than female faces.[1,2,5] The key differences are as follows:



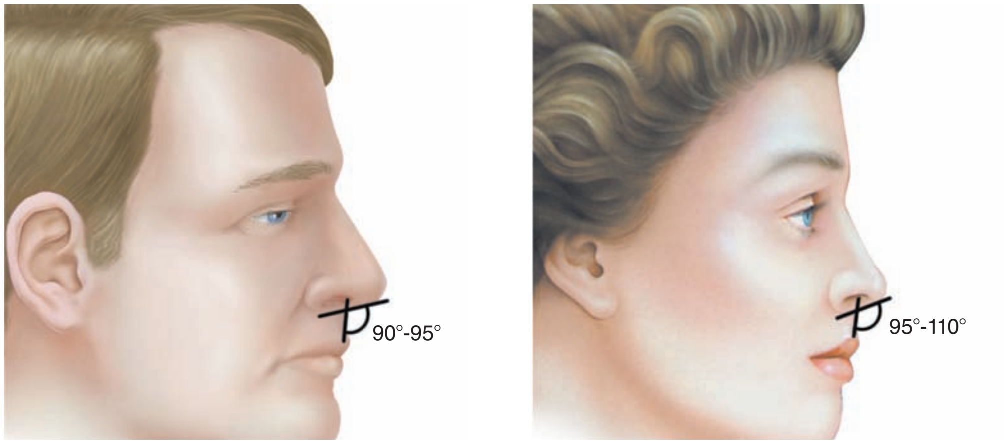
1. The male nasal dorsum tends to be wider and straighter, with less concavity at the superciliary ridges.[1,2,8]



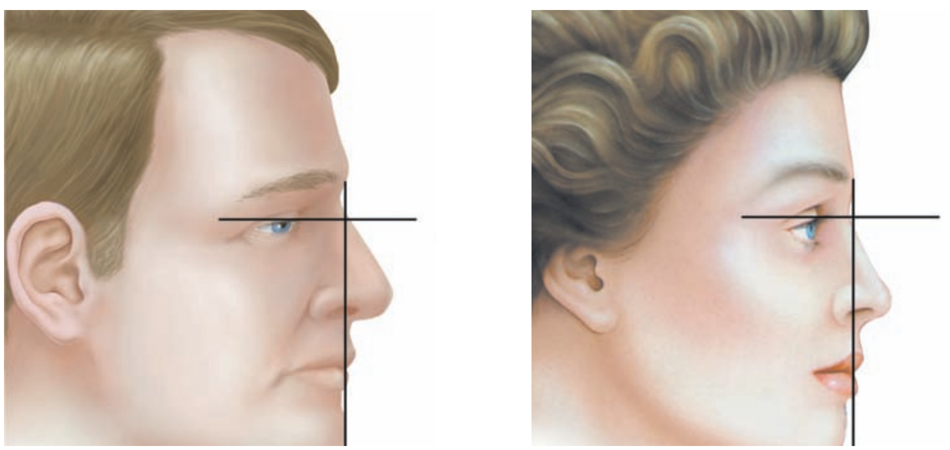
2. The male nasal dorsum should lie along a line drawn from the radix to the tip-defining point (*TDP)* (versus 2 mm behind and parallel to this line in women).[2,7]



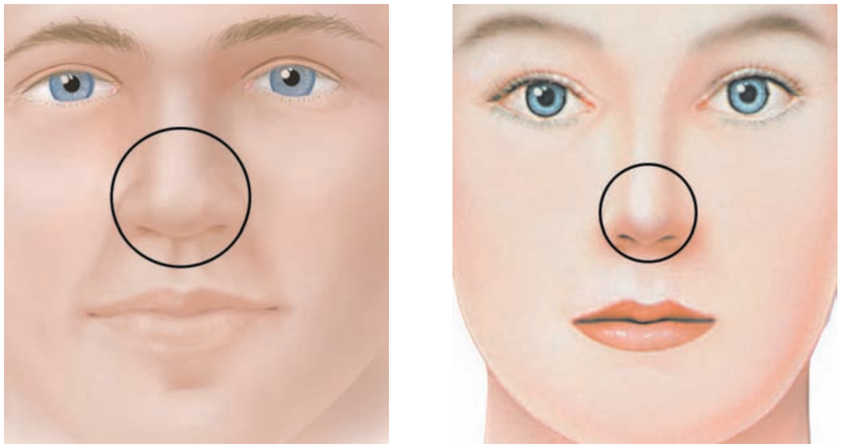
3. Men should not have a supratip break.[2,8]



4. Men have slightly less tip rotation (90 to 95 degrees versus 95 to 110 degrees in women), because the nasal dorsum is longer, which results in less nostril show.[1,2,8]



5. The male chin is more prominent, projecting to a plumb line dropped from a point half the ideal nasal length tangential to the vermilion of the upper lip (versus 2 to 3 mm posterior to this line in women).[2,6]



6. The nasal tip in men is broader and more bulbous than in women.[2,5]
7. The skin of males tends to be thicker, limiting the amount of change that can be achieved.[9]

OPERATIVE GOALS AND PRINCIPLES OF TREATMENT

The overriding objective in male rhinoplasty is to produce a subtle change, with a natural-appearing result and panfacial harmony. Generally a small nose on a male face is inappropriate.

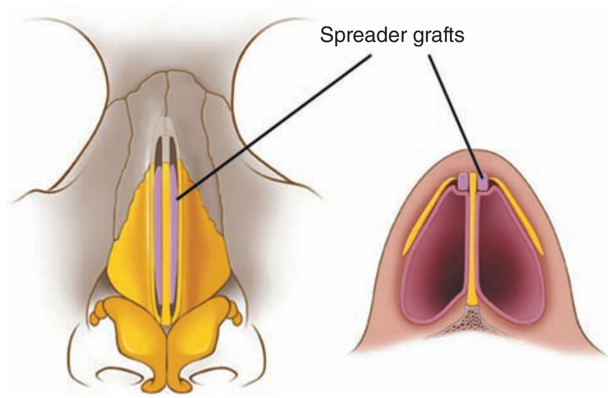
Rhinoplasty in males typically produces more subtle results than in females.

Deformities of the male nose can be classified as either *aesthetic* or *traumatic,* with traumatic deformities categorized as *acquired* or *iatrogenic.*[1] Correction of deformities can include reduction of a prominent dorsal hump, narrowing of the nasal base, refinement of the tip complex, and correction of the aging nose or ethnic nose. Males frequently benefit from dorsal hump reduction, tip modification, and osteotomies. Septal reconstruction, cartilage graft harvest, and inferior turbinoplasty may be indicated in select cases. We will briefly describe highlights of each technique.

The most common deformities in males include a prominent dorsal hump, widened nasal bones, poor definition of the tip complex, and an ethnic nose.

Dorsal Hump Reduction

An open approach with a component dorsal hump reduction is employed. This technique preserves the upper lateral cartilages and helps to prevent injury to the mucoperichondrium. The upper lateral cartilages can be incrementally reduced independent of the septum to improve dorsal aesthetic lines and maintain internal valve integrity. Deformities and internal nasal valve dysfunction can result from a failure to preserve the middle vault. Large dorsal hump reductions with an associated open roof deformity can be corrected either by dorsal onlay grafts or by lateral percutaneous perforated osteotomies with greenstick infracturing of the nasal bones.

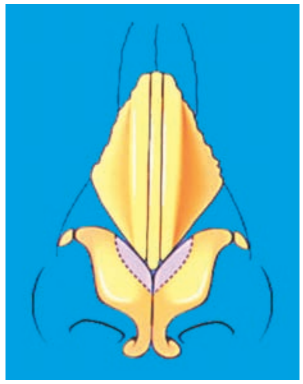


In patients whose internal nasal valve cannot be restored using the upper lateral cartilages or correction of the deviated nose, spreader grafts can help to stabilize the septum (and to prevent an inverted-V or saddle-nose deformity), to maintain the internal valve, and to preserve the dorsal aesthetic lines.[2,10-12] These grafts, usually obtained from septal cartilage, are designed to measure approximately 25 to 30 by 3 mm. They can be placed with the caudal end at the septal angle if the patient does not want the nose lengthened, or beyond this angle if lengthening is needed.

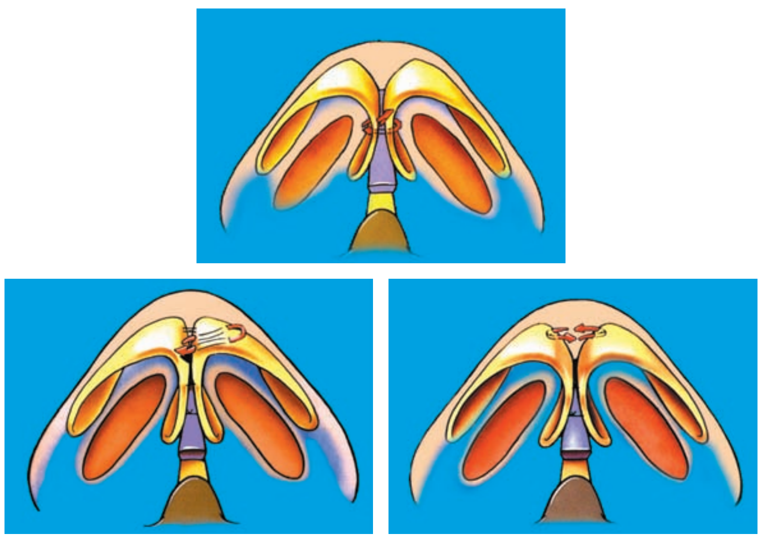
Tip Modification

Tip modification and definition are more challenging in male patients, because they have thicker overlying skin that camouflages modifications made to the underlying osteocartilaginous framework. Therefore more aggressive maneuvers may be required to produce a mild change. A graduated approach is used that involves suture techniques, cephalic trim, columellar strut grafts, and tip grafts.[13]

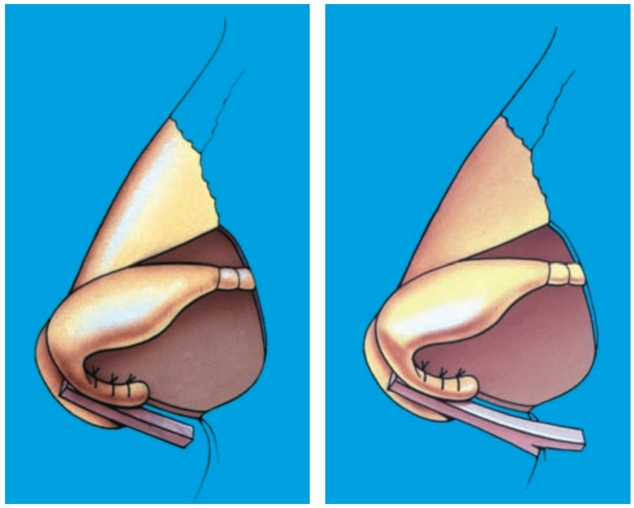
The thick nasal skin that is typical of male patients limits tip modification and definition.



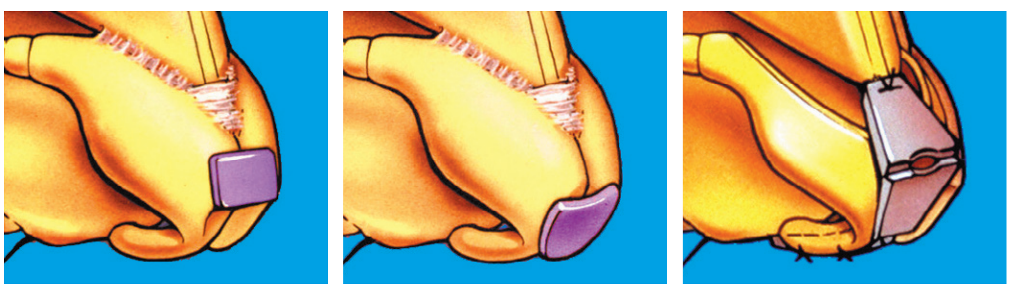
In thick-skinned men, cephalic trim of the lower lateral cartilages allows medialization of the tip-defining points.[2]



Refinement can be accomplished by the use of suture techniques, specifically intercrural, interdomal, and transdomal suturing, which are described in detail in Chapters 10, 17, and 21.[2,14]



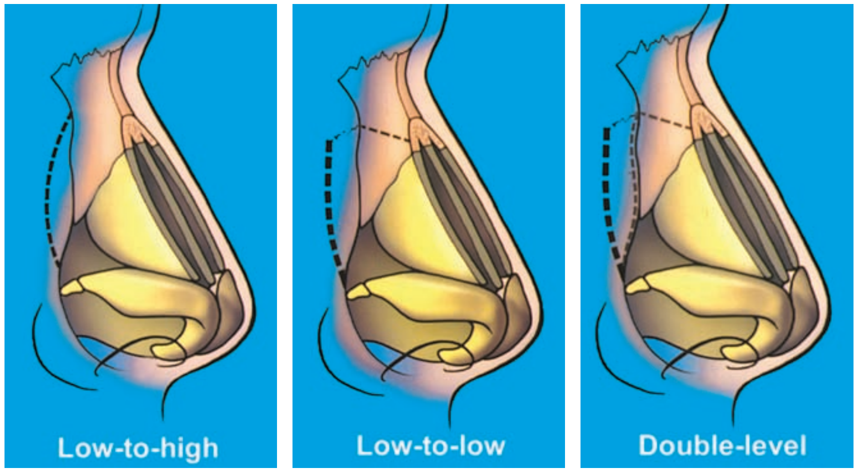
Columellar strut grafts can be used to unify the tip complex and maintain tip projection.[2] Two types of struts are described: the floating strut and the fixed strut. A floating strut is placed between the medial crura approximately 2 to 3 mm in front of the nasal spine, whereas a fixed strut actually rests on the nasal spine itself. A fixed strut is used if tip projection needs to be increased. Both types are secured at the junction of the medial and middle crura. Floating struts are most commonly fashioned from septal cartilage, whereas fixed struts are usually from rib grafts. These struts are designed to measure approximately 25 by 3 mm.



Finally, if necessary, tip grafts can accentuate the tip-defining points and enhance projection in male patients who have especially thick skin.[2] Several different grafts have been described, including the infralobular graft, the onlay graft,[15] and the combination graft.[16] However, caution is crucial to prevent overrefinement of the tip, which will feminize the nose.

Feminization of the male nose should be avoided.

Osteotomies



Wide bony vaults, open roof defects, and deviated nasal bones can be corrected with percutaneous perforated lateral osteotomies.[2] We prefer to perform these osteotomies using a sharp 2 mm straight osteotome[17] (see Chapter 14 for more details). In general, osteotomies should be planned so that the bony base is in proportion (80%) to the alar base.

Septal Reconstruction and Cartilage Graft Harvest

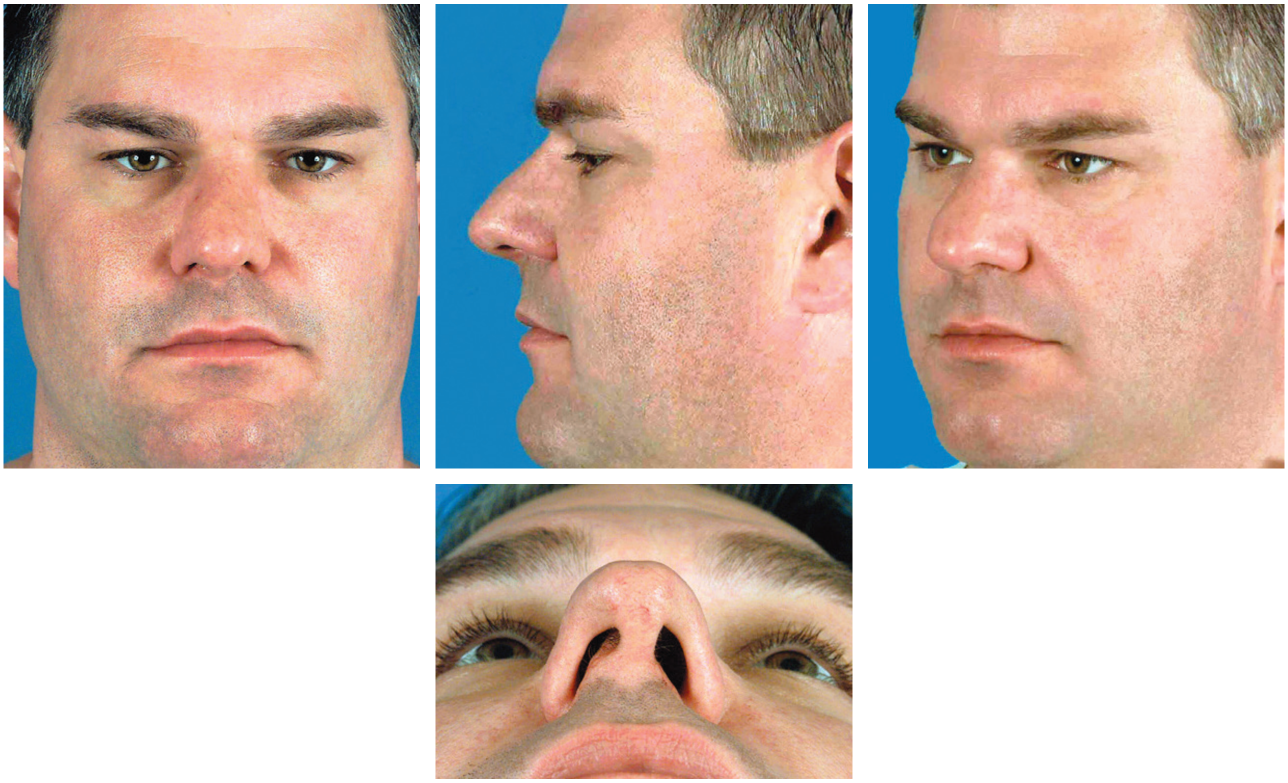
The septum is ideal for cartilage graft harvest in rhinoplasty because of its close proximity to the operating field and its minimal donor site morbidity. When harvesting the graft, the surgeon must preserve an L-strut to support the lower nasal vault. Ideally 15 mm of dorsal septum and 15 mm of caudal septum should be preserved. The septum is dissected in a subperichondrial plane.

Dissection of the septum is done in a subperichondrial plane.

Inferior Turbinoplasty

Inferior turbinate outfracture or submucous resection of the anterior one third to one half of the inferior turbinate is performed in patients with symptomatic nasal airway obstruction secondary to inferior turbinate hypertrophy that is resistant to medical management.[18,19] Submucous resection is carried out by developing mucoperiosteal flaps to expose the conchal bone and sharply resecting the proper amount. The flaps are replaced after this resection. The extent of conchal bone resection is limited to the anterior portion, mainly to prevent complications of bleeding if the posterior portion is resected.

CASE ANALYSES



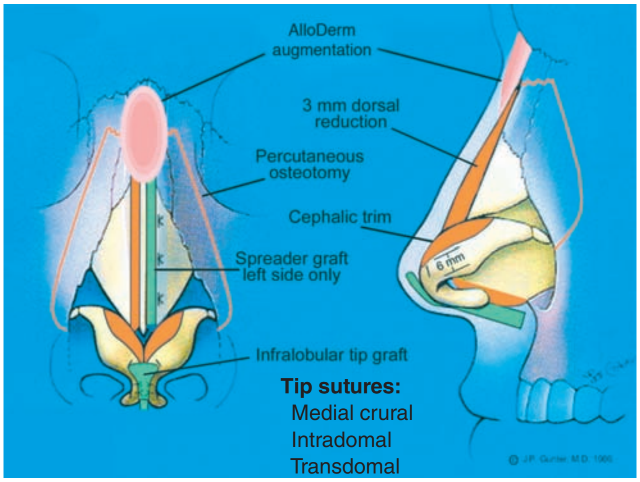
This 38-year-old man complained of a small dorsal hump, an ill-defined tip, and septal deviation causing nasal airway obstruction (left greater than right).[2] Nasal analysis demonstrated the following:

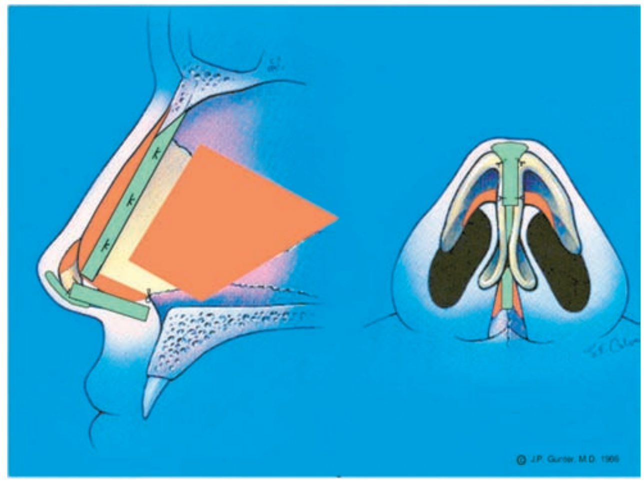
- A dorsal hump
- An indistinct radix
- Right caudal septal deviation
- Left posterior septal deviation
- Compensatory inferior turbinate hypertrophy (right greater than left)
- A wide bony base (right greater than left)
- Slight overrotation
- A bulbous tip

The operative goals included the following:

- Perform incremental component dorsal hump reduction.
- Augment the radix with an allograft.
- Reconstruct the septum and correct caudal septal deviation.
- Resect the anteroinferior turbinates submucosally (more on the right side).

- Bilaterally resect (right greater than left) the anterior inferior turbinate submucosa.
- Perform percutaneous perforated lateral osteotomies.
- Perform cephalic trim, with a graduated approach to tip suturing for derotation and refinement.





Surgical Plan

1. Perform an open approach procedure with a stair-step transcolumellar incision connected to bilateral infracartilaginous incisions.
2. Make a left hemitransfixion incision to approach the septum (to correct caudal deviation).
3. Secure the caudal septum to the anterior nasal spine with 5-0 PDS.
4. Reduce the dorsal hump incrementally (3 mm) and in component fashion (bony/cartilaginous).
5. Augment the radix with an allograft.
6. Place a left spreader graft.
7. Perform bilateral inferior turbinate submucosal resection (anterior).
8. Perform cephalic trim of the lower lateral cartilages, leaving a 6 mm alar rim strip.
9. Refine the tip with intercrural, interdomal, and transdomal sutures (5-0 PDS).
10. Place an infralobular tip graft to define and lengthen the tip.
11. Perform percutaneous perforated lateral osteotomies.

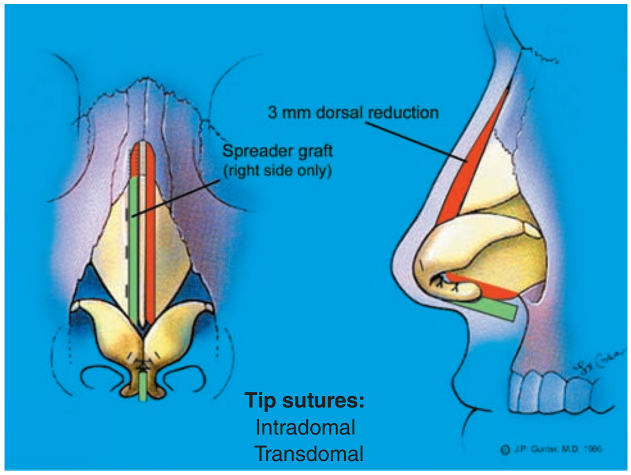
The patient is shown 6 months postoperatively.[2] The anteroposterior view shows improved dorsal aesthetic lines, well-defined tip-defining points, and a more proportional bony base width. The oblique and lateral views confirm that the dorsum is straight and the projection is adequate. The basal view reveals a straightened caudal septum and refined tip.

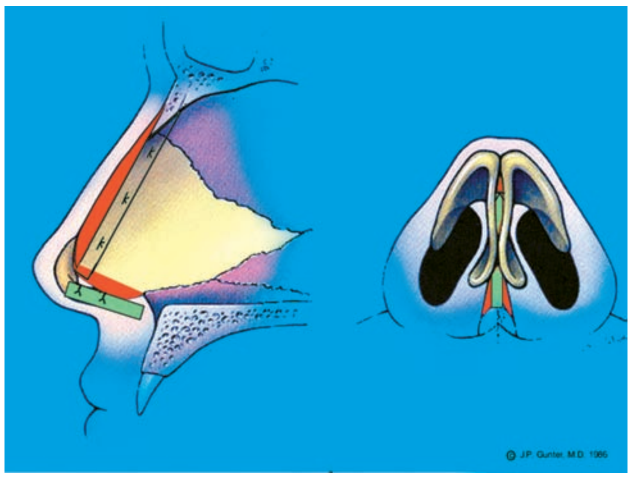
This 40-year-old man had concerns about a persistent dorsal hump and right nasal airway obstruction despite his having undergone rhinoplasty several years earlier.[2] Nasal analysis demonstrated the following:

- A dorsal hump
- Weakly defined dorsal aesthetic lines
- A prominent caudal septum
- An underprojecting tip complex
- A narrowed right internal nasal valve

The operative goals included the following:

- Perform an incremental component dorsal hump reduction.
- Resect the caudal septum.
- Reconstruct the septum with placement of a right spreader graft.
- Increase tip projection with a columellar strut graft.
- Refine the tip using a graduated approach to tip suturing.





Surgical Plan

1. Perform an open approach procedure with a stair-step transcolumellar incision connected to bilateral infracartilaginous incisions.
2. Resect the dorsal hump incrementally (3 mm) and in component fashion (bony/cartilaginous).
3. Resect 2 mm of the caudal septum.
4. Place a right spreader graft.
5. Place a columellar strut graft.
6. Refine the tip with intercrural and transdomal sutures (5-0 PDS).

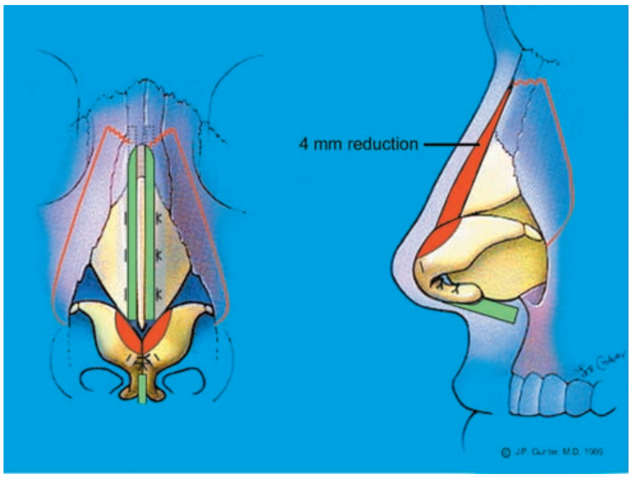
The patient is shown 2 years postoperatively.[2] The anteroposterior view shows improved dorsal aesthetic lines, and defined, symmetrical tip-defining points are evident. The oblique and lateral views confirm that the dorsum is straight, and the basal view demonstrates improved tip definition.

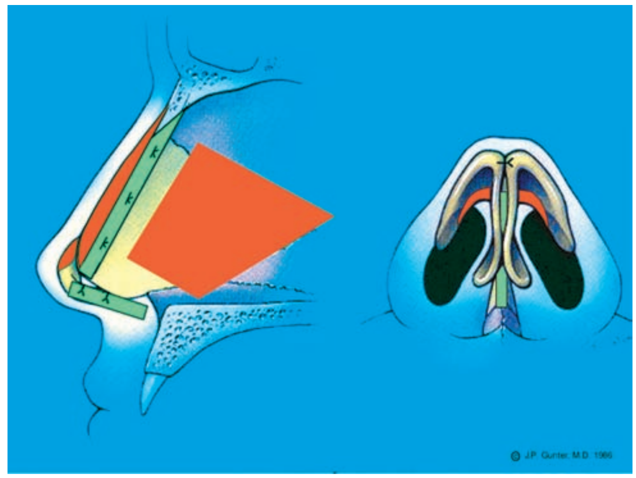
This 31-year-old man had a history of preexisting nasal trauma to the left side of his nose. He requested straightening of his nose, removal of nasal airway obstruction, improvement of the bulbous asymmetrical tip, correction of the wide nasal base and dorsal hump, and augmentation of his small chin. Nasal analysis demonstrated the following:

- Adequate facial proportions, with microgenia and class I occlusion
- Left middle vault collapse, with left nasal deviation and a C-shaped septal deformity
- A wide bony base
- A bulbous, asymmetrical nasal tip
- Slight alar flaring (left greater than right)
- A dorsal hump
- Right nasal airway obstruction by the right anteroinferior turbinate, with inferior hypertrophy on the left

The operative goals included the following:

- Correct the nasal airway obstruction.
- Reduce the dorsal hump.
- Correct the nasal septal deviation.
- Improve nasal tip symmetry.
- Perform an osseous advancement genioplasty to correct microgenia.

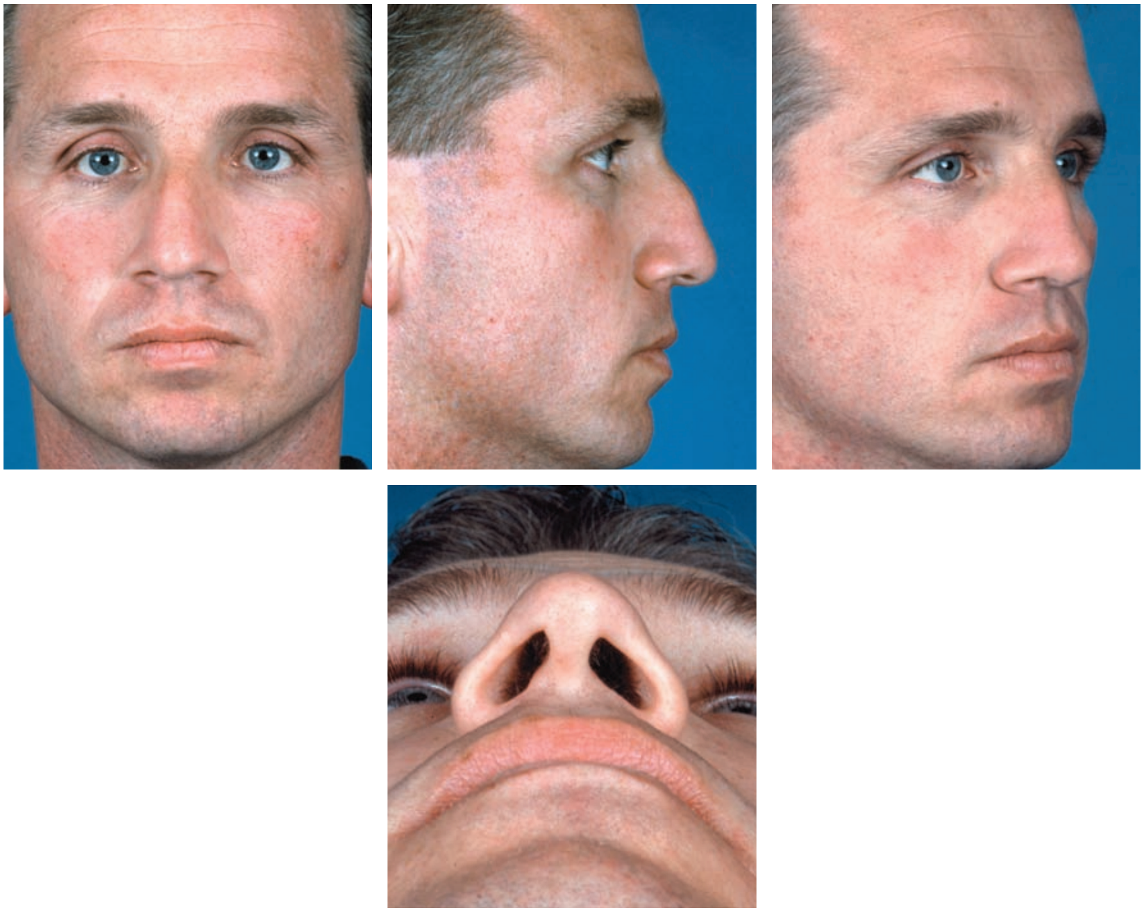




Surgical Plan

1. Perform an open approach procedure with a transcolumellar incision and infracartilaginous extensions.
2. Expose the nasal framework.
3. Reduce the dorsal hump by 3 mm in component fashion.
4. Expose the nasal septum and harvest a septal cartilage graft.
5. Resect inferior turbinates submucosally and bilaterally.
6. Place bilateral spreader grafts and secure them with three 5-0 PDS horizontal mattress sutures.
7. Perform cephalic trim and retain a 6 mm alar rim strip.
8. Place a columellar strut graft.
9. Place intercrural, interdomal, and transdomal sutures (5-0 PDS).
10. Score the caudal septum.
11. Create a swinging-door flap with a figure-of-eight suture to the contralateral periosteum of the anterior spine and 5-0 PDS to maintain the caudal septum deviation.
12. Perform percutaneous perforated lateral osteotomies.

Eight years postoperatively, the frontal view shows a straight nasal dorsum with improved dorsal aesthetic lines and tip refinement. Slightly more alar convexity and some increased infratip lobular projection persists. The oblique and lateral views show a normal radix and minimal supratip break, a nasolabial angle of 95 degrees, improved nasolabial and alar-columellar relationships, and tip refinement. The alae and nasal base are in better proportion, and the general facial proportions are good after correction of microgenia. The tip is symmetrical. The basal view reveals improved triangularity of the straight nasal tip and better projection of the columellar–infratip lobule. Some asymmetry of the nostrils and slight alar convexity bilaterally (more on the right than the left) remain. Nasal airway obstruction is improved.

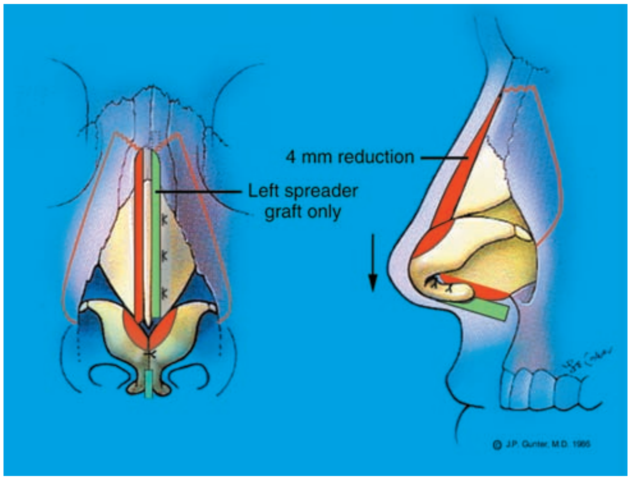


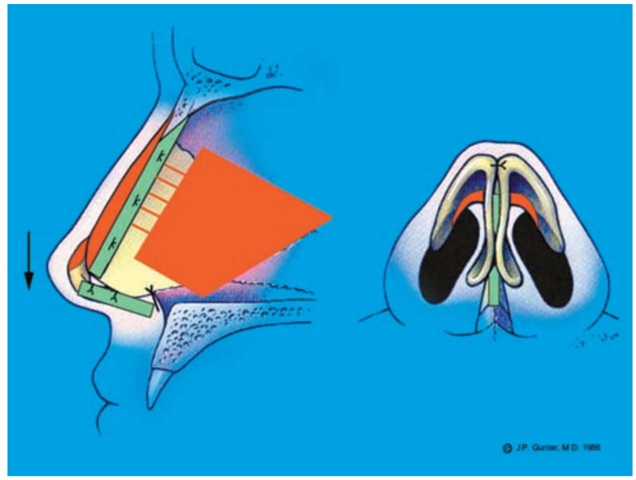
This 35-year-old patient with thin Fitzpatrick type II skin had a history of nasal trauma and nasal airway obstruction (more on the right than the left). His major complaints were nasal airway obstruction, high dorsal nasal deviation, and a dorsal hump. Nasal analysis demonstrated the following:

- Adequate facial proportions
- Left middle vault collapse with left nasal deviation and a C-shaped septal deformity
- Incomplete dorsal aesthetic line definition ending at the midvault
- Left nasal tip deviation
- Slightly decreased tip projection and adequate nasal length
- A dorsal hump
- A nasolabial angle of approximately 85 degrees
- Splaying/deviation of the medial crural footplates to the right
- Thickened nasal mucosa on intranasal examination with right caudal septal deflection and posteroinferior septal deviation obstructing 85% of the airway
- Left inferior turbinate hypertrophy

The operative goals included the following:

- Correct the nasal airway obstruction.
- Correct the dorsal hump.
- Correct the deviated septum.
- Revise tip asymmetry.





Surgical Plan

1. Perform an open approach procedure with a transcolumellar incision and infracartilaginous extensions.
2 Reduce the dorsal hump by 4 mm in component fashion.
3. Correct the septal deviation and harvest septal cartilage grafts posteriorly and inferiorly.
4. Reduce the dorsocaudal septum by 2 mm.
5. Score the caudal septum.
6. Create a swinging-door flap to correct caudal septal deflection with a figure-of-eight suture to the contralateral periosteum of the anterior nasal spine and 5-0 PDS to correct the septal deviation caudally.
7. Make full-thickness inferior cuts through 50% of the septum, and place a left spreader graft to correct the deviated septum.
8. Perform cephalic trim, leaving a 6 mm alar rim strip.
9. Apply a columellar strut graft.
10. Place intercrural and interdomal sutures only.
11. Perform percutaneous perforated lateral osteotomies.

The patient is shown 18 months postoperatively. The oblique view shows a straight dorsum and improved dorsal aesthetic lines. His tip is more refined and in balance with the nasal base. The oblique and lateral views confirm that the radix is normal and the dorsum is straight, with a slight supratip break. The nasolabial angle is approximately 85 degrees. The basal view shows that the caudal septum has been straightened. Some slight deflection of the right medial footplate remains, but the columellar–infratip lobular area is straight. Slight alar notching and alar convexity are evident bilaterally. His nasal airway problems are improved.

POSTOPERATIVE MANAGEMENT

Postoperative management is similar to that described in detail in Chapter 8. An important difference, however, is that generalized edema occurs more commonly in male rhinoplasty patients. This should be discussed explicitly with the patient during the initial consultation and reinforced on informed consent for surgery forms. Steri-Strips are used for at least 2 weeks to help reduce edema.

KEY POINTS

- Certain danger signs suggest that a patient may have an underlying psychiatric disturbance.
- Proper, thorough facial analysis is crucial to ensure appropriate facial harmony and balance.
- Rhinoplasty in males typically produces more subtle results than in females.
- The most common deformities in males include a prominent dorsal hump, widened nasal bones, poor definition of the tip complex, and an ethnic nose.
- Thick nasal skin typical of males limits tip modification and definition.
- Feminization of the male nose should be avoided.
- Dissection of the septum is done in a subperichondrial plane.

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Cleft Rhinoplasty

Richard Y. Ha ▪ Jeffrey D. Cone, Jr. ▪ H. Steve Byrd

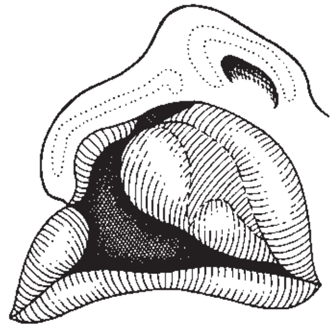
Patients requiring cleft rhinoplasty form one of the most challenging subsets of rhinoplasty patients. The nasal deformity can involve asymmetries and deficiencies of all of the components of the nose, including skin, mucosal lining, cartilage, and skeletal support. Increasingly, the quality of a cleft lip repair is judged by the aesthetics and function of both the lip and the nose.

The goal of cleft rhinoplasty mirrors that of noncleft rhinoplasty—namely, restoring a functional and aesthetic nose. Achieving this goal requires an understanding of the unique anatomy of the cleft nose and an appreciation for the longitudinal care required for cleft patients. After all, previous surgeries either facilitate or hinder future intervention, and changes created in infancy set the foundation for the adolescent/adult rhinoplasty.[1-4]

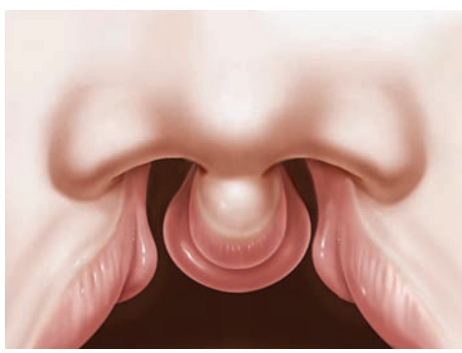
In this chapter we will present the anatomy of cleft nasal deformities for unilateral and bilateral cleft lip. Early surgical modification of the nose is followed typically by a formal adolescent or adult rhinoplasty. The resulting secondary nasal deformities can be categorized into two types—those who have adequate primary nasal reconstruction and those who have not. This classification system and treatment approaches will be discussed.

APPLIED ANATOMY

The anatomic features of unilateral and bilateral cleft noses can be represented across a spectrum of severity from mild (microform) to severe (complete). There may be structural deformities with malposition, as well as intrinsic hypoplasia, that contribute to the external appearance. For example, the cleft-side lower lateral cartilage is commonly found to be smaller in dimensions than that of the noncleft side.

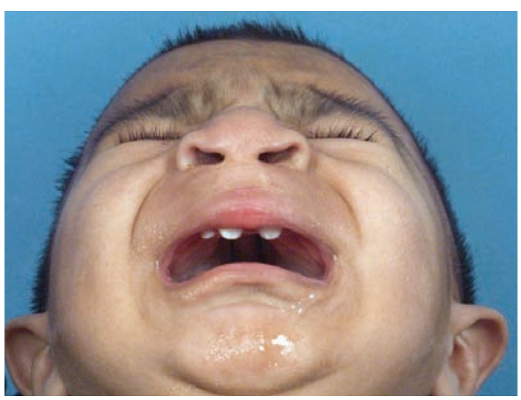


The characteristic features of a unilateral cleft nasal deformity include disruption of the muscle ring across the nasal sill, a splayed cleft-sided medial crus, malposition and hypoplasia of the lower lateral cartilage, a flattened nasal dome, pathologic tethering of the accessory chain of the lower lateral cartilage to the piriform aperture, and soft tissue deficiency of the nasal floor. Characteristic structural deformities on the cleft side include a retrusive maxillary segment, a septum that deviates posteriorly, abnormal insertions of the lip and cheek musculature to the alar base, and vestibular lining deficiency. Malfunction of the cleft ala external valve results from alar base malposition, an imbalanced muscular pull, and abnormal attachment of the cheek muscles to the lateral crus. Tip projection is further compromised by a foreshortened columella, which lies obliquely, with its base directed away from the cleft side.[5,6]



The characteristic features of a bilateral cleft nose include a shortened or absent columella, a deficient or absent anterior nasal spine, a flattened nasal tip, laterally and posteriorly displaced alar bases with accessory chain tethering to the piriform, splayed nasal alae, retrusive maxillae, and recession of the medial crural footplates. Often a protrusive premaxilla accentuates the relative flattening of the nasal tip and shortened columella.

Preoperative photos of this boy illustrate his bilateral cleft lip and nose deformity.



The boy is shown 2 years after primary cheiloplasty and nasal sill reconstruction.

The boy is shown after primary bilateral cleft rhinoplasty with columellar lengthening and domal suturing.

SURGICAL TIMING AND PRIMARY NASAL REPAIR

The early primary rhinoplasty sets the foundation for definitive rhinoplasty performed when the patient is an adolescent or adult. Patients who have had an adequate primary repair have a less significant secondary deformity and require less extensive maneuvers during secondary rhinoplasty.[1,2]

The early primary rhinoplasty sets the foundation for definitive rhinoplasty performed in adolescence or adulthood.

For unilateral cleft lip deformity, the timeline is as follows:

- Presurgical orthopedics (nasoalveolar molding) from 0 to 3 months of age
- Primary cleft nasal repair at the time of cheiloplasty (at approximately 3 months of age)
- Secondary cleft rhinoplasty at the time of skeletal maturity (at approximately 14 to 16 years of age for girls and 16 to 18 years of age for boys).

The surgical goals of the primary cleft nasal repair include the following[1-3]:

1. Recreation of the nasal sill
2. Release and repositioning of the affected ala
3. Augmentation of the nasal lining deficiency on the cleft side
4. Three-point release of the lower lateral cartilage
5. Balancing of the nasal domes

The timeline for bilateral clefts is similar, with the exception that the primary nasal repair is divided in two stages:

1. At the time of the primary cheiloplasty, the nasal repair is limited to alar repositioning and lateral nasal lining augmentation.
2. At approximately 18 months of age, the columella is lengthened (as modified from Cronin and Upton), and the nasal domes are unified.[4]

We delay the definitive adult/adolescent rhinoplasty until the postpubertal growth spurt in the bony dorsum and anterior septum is complete. This occurs roughly after the age of 14 years in females and 16 years in males. We avoid the routine practice of repeated rhinoplasty procedures throughout the patient's childhood, because the resultant scarring can compromise the final long-term result.

In patients with adequate primary repair, we do not operate on the nose again until the definitive rhinoplasty at the completion of growth.

DEFINITIVE ADOLESCENT/ADULT RHINOPLASTY

Although successful completion of the surgical objectives of a primary cleft rhinoplasty may provide excellent outcomes, extrinsic (scar, deformation) and intrinsic (hypoplasia) factors may lead to progressive adverse changes to the cleft nasal deformity during growth. In adolescents and adults, recurrent alar and tip deformities are common and unilateral airway obstruction from septal deviation can be seen. Most patients with complete cleft lip and nasal deformity will likely benefit from definitive rhinoplasty as an adolescent/adult. The surgical approach can be tailored based upon the degree of residual deformity and whether an adequate primary repair was performed. Patients can thus be segregated into two categories, type I and type II.

Type I Patients in this category have minimal to moderate deformity who had adequate primary release. This type is most commonly encountered in microform and incomplete clefts. In general, the nasal function is adequate and the desired changes from rhinoplasty are aesthetic. Accordingly, traditional rhinoplasty techniques such as tip suturing and columellar struts are employed.

Type II Type II patients have moderate to severe deformity, with suboptimal primary reconstruction. Patients with a history of bilateral cleft lip and nasal deformities also tend to fall in this category as a result of more severe tip underprojection. Both the nasal function and the nasal aesthetics are poor, and the desired changes of secondary rhinoplasty are reconstructive. More extensive techniques

are required to provide increased structural support. These include rib grafts, lateral crural strut grafts, alar batten and contour grafts, composite alar rim grafts, and periapical/alar base augmentation.

To distinguish between type I and type II, five questions are asked concerning the primary reconstruction (on the cleft side), based on the patient's physical examination:

1. Was there adequate lateral alar release from the piriform aperture?
2. Was nasal muscle reconstructed across the nasal sill?
3. Was the nasal lining adequately supplemented?
4. Were the nasal dome and lateral crura sufficiently repositioned?
5. Did the patient have a history of a bilateral cleft lip/nose?

The primary repair of the cleft nasal deformity must address four key features associated with the deformity: (1) release of the lateral ala from its abnormal attachment to the piriform aperture, (2) deficiency of the nasal lining, (3) reconstruction of the muscles of the nasal sill, and (4) repositioning of the dome with correction of the caudal rotation of the lower lateral cartilage.

With optimal primary cleft nasal repair, the muscle forces are rebalanced and the alar cartilages are repositioned to a more anatomic configuration.[1,3] Consequently, the definitive rhinoplasty in such patients can be managed with standard rhinoplasty techniques. A negative response to the first four questions reveals either an unrepaired or an inadequately repaired cleft nasal deformity.[2] Such nasal deformities and those with bilateral cleft noses with severely underprojected tips are classified as type II, and techniques with increased structural support are required.

Secondary rhinoplasty of an adequately repaired cleft nose will consist of standard rhinoplasty techniques.

For type I patients, the common residual deformity includes an underprojected tip, septal deviation (often with airway obstruction), cleft-side lower lateral cartilage weakness (and external nasal valve malfunction), dorsal deformity, and deficient piriform aperture (maxillary deficiency). These features and recommended techniques are listed in the following table. The most common maneuvers include columellar strut grafts or extended spreader grafts for increased tip projection, alar contour grafts, functional septoplasty, and augmentation of the piriform aperture.

Type I Deformity Features and Recommended Techniques

Analysis	Deformity	Techniques
Nasal base	Retrusive maxilla and nasal base	Skeletal augmentation of the piriform aperture (hydroxyapatite, bone, cartilage, alloplasts)
Septum	Septal obstruction	Septoplasty
Nasal dorsum	Deficient dorsum	Dorsal augmentation with rib or septal cartilage graft
	Overprojecting dorsum	Dorsal reduction (bony and/or cartilaginous) with autospreader flap ± spreader graft on concave side
	Deviation	Dorsal L-strut scoring/suturing for straightening Spreader graft (to concave side) Clocking sutures from upper lateral cartilage to septum
	Wide nasal bones	Lateral osteotomies (internal or external) Medial osteotomies
Nasal tip	Underprojecting tip	Columellar strut graft (septal or rib cartilage) Extended spreader graft (septal cartilage) Infratip lobular graft (septal cartilage) Tip graft (septal or ear cartilage)
	Acute columellar-labial angle	Columellar strut graft Possible caudal septal resection or columellar base cartilage graft
	Lack of tip definition	Interdomal sutures Transdomal sutures Tip grafts (septal or ear cartilage) Cephalic trim
Ala and lower lateral cartilage	Collapse/weakness of lateral crus	Cartilage scoring Alar contour graft (anatomic or nonanatomic); septal cartilage
Soft tissue triangle	Alar notching Alar retraction	Alar contour graft (nonanatomic) Composite auricular cartilage graft
Maxilla	Class III malocclusion with maxillary hypoplasia	LeFort I osteotomy and maxillary advancement

A columellar strut graft is indicated when combining LeFort I advancement with rhinoplasty.

For type II patients, standard rhinoplasty maneuvers are often insufficient to overcome cicatricial forces or tissue deficiency, especially lining. Rib cartilage grafts are used in greater frequency for donor cartilage because of its increased rigidity. The most common maneuvers for these patients include columellar strut grafts (rib), lateral crural strut grafts, extensive secondary release of the lateral crus with repositioning, onlay or tip grafts, and correction of soft tissue deficiencies (composite cartilage or mucosal grafts). These features and recommended techniques are listed in the table.

Type II Deformity Features and Recommended Techniques

Analysis	Deformity	Techniques
Nasal base	Retrusive maxilla and nasal base	Skeletal augmentation of piriform aperture (hydroxyapatite)
Septum	Septal deviation	Vomerian/septal/ethmoidal resection
		Septoplasty
Nasal dorsum	Deficient dorsum	Dorsal augmentation with rib or septal cartilage graft
	Overprojecting dorsum	Dorsal reduction (bony and/or cartilaginous) with autospreader flap ± spreader graft on concave side
	Deviation	Dorsal L-strut scoring/suturing for straightening
		Spreader graft (to concave side)
		Clocking sutures from upper lateral cartilage to septum
	Wide nasal bones	Lateral osteotomies (internal or external)
		Medial osteotomies
Nasal tip	Underprojecting tip	Columellar strut graft with rib (tenth rib, 30 to 40 mm)
	Acute columellar-labial angle	Columellar strut graft with rib (tenth rib, 30 to 40 mm)
	Lack of tip definition	Interdomal sutures
		Transdomal sutures
		Tip grafts (septal or ear cartilage)
		Cephalic trim
	Lack of tip definition	Interdomal sutures
		Transdomal sutures
		Tip grafts (septal or ear cartilage)
		Cephalic trim
Ala and lower lateral cartilage	Collapse of lateral crus	Lateral crural strut grafts (rib or septal cartilage)
		Alar contour graft (anatomic or nonanatomic); septal cartilage
	Displaced ala (malposition)	Lateral crural transection and repositioning
		Lateral crural strut graft
		V-Y nasal lining advancement
		Alar contour grafts
	Hypoplastic lower lateral cartilage	Lateral crural strut graft
		Alar contour graft (from septal cartilage)
		Dissection of scroll area
		Lateral crural transection with medial advancement
		Ipsilateral domal onlay grafts
Soft tissue triangle	Alar notching	Alar contour graft (nonanatomic)
	Alar retraction	Composite auricular cartilage graft
Maxilla	Class III malocclusion with maxillary hypoplasia	LeFort I osteotomy and maxillary advancement
Vestibular stenosis	Webbing/contracture	Z-plasty nasal lining (mild cases only)
		Full-thickness mucosal grafts
		Nasal stenting
		Composite cartilage grafts

The cleft-side lower lateral cartilage is not only malpositioned but also hypoplastic, and both of these features must be addressed in the correction.

OPERATIVE TECHNIQUE

For most cleft nasal deformities, we prefer an open rhinoplasty approach. After dissection of the skin envelope through a transcolumellar incision, the lower lateral cartilages are dissected. The upper lateral cartilages are separated from the dorsal septum, and the nasal bones are exposed subperiosteally. The septum is first addressed with a wide vomerian-septal-ethmoid resection under direct vision, leaving an 8 to 10 mm dorsal and caudal L-strut. The septal deviation is addressed by mobilizing and securing the caudal septum to the midline; this may require additional cartilage scoring and/or suture techniques for straightening.

We next determine whether the dorsum is deficient, overprojecting, or normal. Reconstruction of a nose with a deficient dorsum requires a rib graft.[7] We preferentially harvest the tenth rib cartilage, which will provide, on average, a 33 mm segment for use as a columellar strut and a 40 mm segment to use for a dorsal graft.

In a cleft nose with an overprojecting dorsum, the septum and nasal bones must be reduced. We prefer to use the excess upper lateral cartilage as an autospreader flap, which can be reinforced with a traditional spreader graft on the concave side. Once reduced, we narrow the nasal bones with percutaneous lateral osteotomies (J or low-to-high).

In the cleft nose with normal dorsal projection, the nasal bones will often be wide. We narrow the nasal bones with lateral osteotomies and medial osteotomies. If there is significant septal curvature or deviation, a spreader graft on the concave side and clocking sutures between the upper lateral cartilage and septum will help bring the septum to the midline.

The nasal bones are narrowed with lateral osteotomies and medial osteotomies.

Spreader grafts are used on the concave side of the deviated septum.

Next we assess the degree of tip deformity. A columellar strut graft using rib cartilage is indicated if tip projection is inadequate, the lateral crus is collapsed, or the columellar-labial angle is acute.

Our indications for a columellar strut graft in the definitive rhinoplasty include inadequate tip projection, dorsal deficiency, collapse or buckling of the lateral crus, an acute columellar-labial angle.

Rib cartilage is a powerful tool in correcting the cleft nasal tip deformity. The strength of rib cartilage will withstand the shortage of soft tissue in the columella. Cleft noses will often exhibit thick soft tissues and require a differential tip projection of 8 to 12 mm beyond the level of the nasal dorsum to avoid a supratip deformity.[8] The bulk of a columellar strut graft will lift the lip and achieve a more obtuse columellar-labial angle, creating an aesthetic fullness and youthful curve to the central lip.

An added advantage to using rib cartilage for the columellar strut is that it allows all of the harvested septal cartilage to be used in tip and alar reconstruction. Correct placement of the columellar strut graft is important. The convexity of the rib graft should be placed cephalad, which allows the medial crus to be joined in front of the graft. This orientation avoids an unaesthetic widening of the columella. The rib can be secured to the anterior nasal spine with sutures or with a threaded K-wire.

Rib cartilage is preferred to septal cartilage for use as a columellar strut graft because of its strength. Correction of the tip deformity requires a columellar strut graft to provide tip projection, improve the lateral crus deformity, make the columellar-labial angle more obtuse, and provide a youthful fullness to the central lip.

Next, the position of the alar base and lateral crus is assessed. Specifically, if the accessory chain of the lateral crus remains attached to the piriform aperture, it is released by dissecting the perialar muscles away from the cheek and lip musculature. This dissection goes deep to the nasal lining and involves a release of the fibrocartilaginous attachments to the piriform aperture. The dissection also extends across the nasal sill and is connected to the midline dissection of the columella.

Once completely released, the ala should be freely mobile across the cleft. The alar base is then sutured to the noncleft side medial footplate. This rotates and repositions the alar base and brings muscle across the nasal sill. Finally, a suture is placed from the released portion of the lateral crus to the cheek muscles to create a functional cleft side external valve by attaching the released cheek muscles to the external valve.

The relative hypoplasia of the cleft-side lower lateral cartilage is then assessed. If there is minimal hypoplasia with minor alar deformities (such as concavities), scoring and suturing techniques can be utilized to restore the natural convexity of the lower lateral cartilage. However, if the hypoplasia is severe, or if the cicatricial forces of the lining and/or cartilage prevents elevation of the lower lateral cartilage toward the dome, structural reconstruction is performed with both a lateral crural strut graft and an anatomic alar contour graft. The lateral crural strut graft will usually measure 3 to 4 mm by 28 to 30 mm and are placed in a pocket created by elevating the lining on the underside of the cartilage. The strut graft stabilizes external valve incompetence that can be produced by the lateral release.[9] An alar contour graft of residual septum is then fashioned to span from the dome out beyond the alar crease.[10] These grafts essentially sandwich the abnormal alar cartilage.

Correction of the hypoplastic lower lateral cartilage requires the use of a lateral crural strut graft and alar contour graft.

The lower lateral cartilage may need to be further released from the upper lateral cartilage along the scroll. This release can include a V-Y advancement of the nasal lining if the lining is tight and restricting movement of the lower lateral cartilage. Alternatively, the lateral portion of the lateral crus can be transected to freely mobilize it towards the dome; in this case, a lateral crural strut graft should be added for stability of the lateral crus. Finally, an onlay domal graft on the cleft-side lower lateral cartilage can be used if there is persistent domal asymmetry or depression.

Correction of the position of the ala involves release of the lower lateral cartilage from the piriform aperture, V-Y advancement of the nasal lining, reconstruction of the nasal sill, and reconstruction of the external nasal valve.

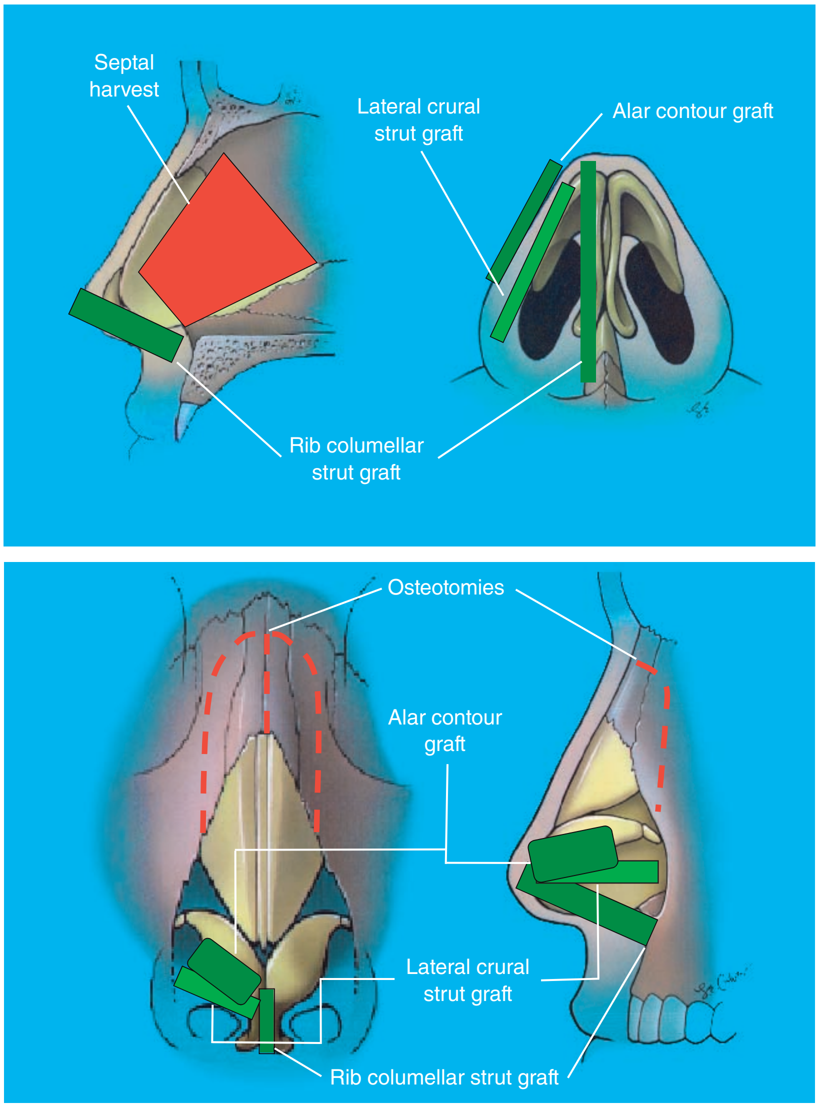
Domal mattress sutures are added to further define the domes. The domes are sutured over the projecting rib columellar strut. A slight overprojection of the cleft lateral crus and domal segment is allowed to compensate for the tight soft tissue envelope on the cleft side.

Piriform augmentation can be performed at this point. Approach is through an intraoral incision to place hydroxyapatite granules (rib/bone grafts or alloplasts can also be used). In the cleft patient who also requires a maxillary advancement, definitive cleft rhinoplasty can be performed simultaneously; however, rib grafts are strongly recommended for columellar support. Even for small maxillary advancements, a columellar strut graft will help improve the columellar-labial angle. Stability of the LeFort maxillary segment is critical, otherwise malposition or displacement of the caudal columellar strut graft is a possible complication.

The nasal skin is then redraped and the transcolumellar and intranasal incisions closed. Standard external and/or internal splint application is recommended.

CASE ANALYSES

This 15-year-old patient had a right unilateral cleft nasal deformity. Note the poor tip projection and collapsed right ala.

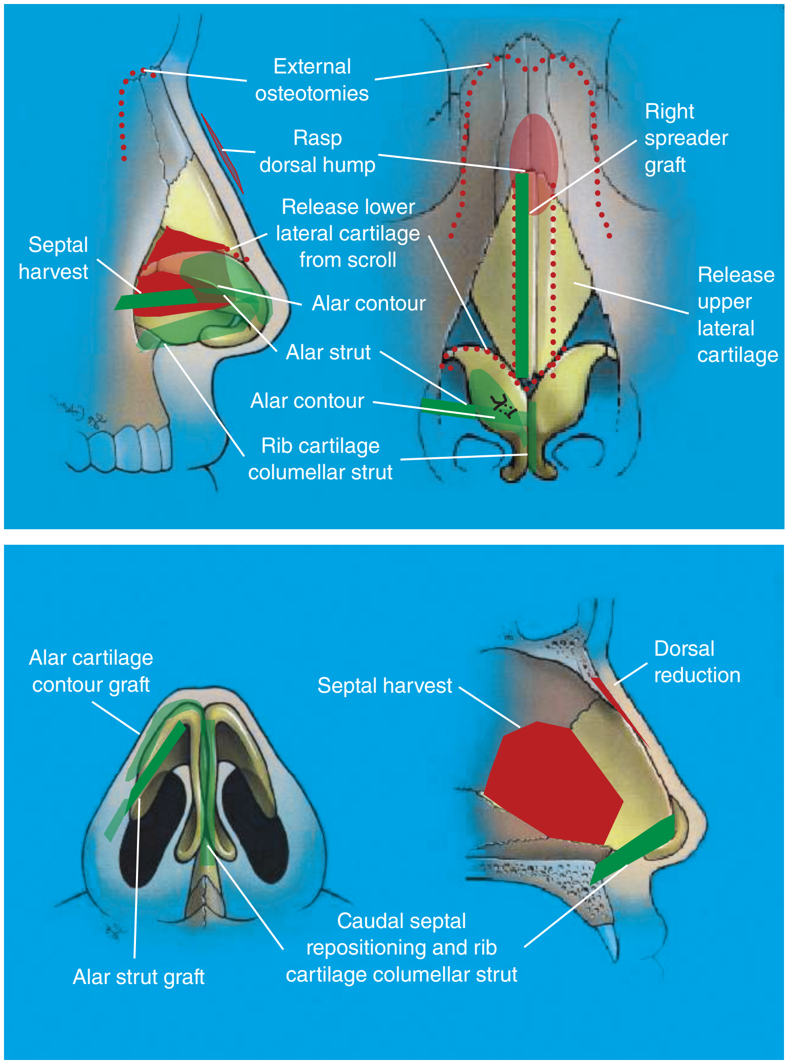


The tenth rib cartilage was harvested and used as a columellar strut graft. Septal cartilage was used for alar strut and contour grafts on the cleft side.

The patient is shown 1 year postoperatively. The columellar strut graft has improved the nasal tip projection and created a more defined supratip break.

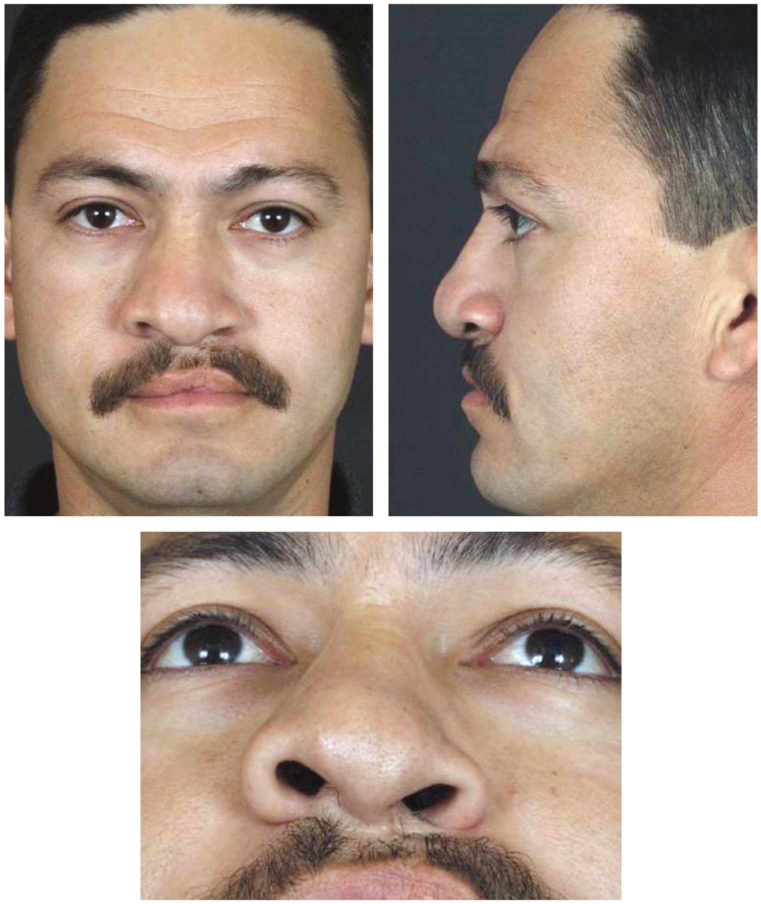
The right alar contour is improved with the alar contour graft, as demonstrated in overhead and basal views.

This 42-year-old patient had a right unilateral cleft nasal deformity. She had poor tip projection, a severely hypoplastic and deformed right cleft sided ala, a malpositioned alar base, and septal deviation with nasal airway obstruction. She had a prominent dorsum and desired dorsal reduction.

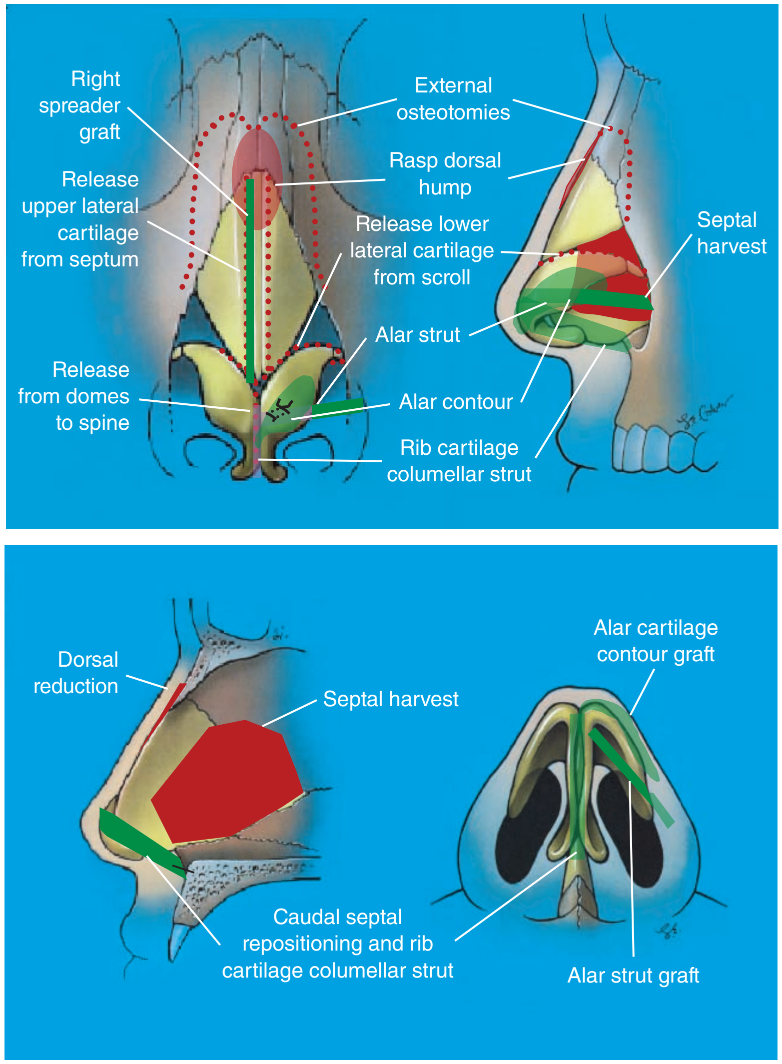


A columellar strut graft was fashioned from rib cartilage. Septal cartilage was used for a lateral crural strut graft and alar contour graft. Extensive release of the right lower lateral cartilage was performed, including dissection/release of the scroll area and lateral crural transection.

The patient is shown 2 years postoperatively. Note the improved nasal tip projection, supratip break, and alar symmetry. The columellar strut graft must project 10 mm above the nasal dorsum to achieve an adequate supratip break.

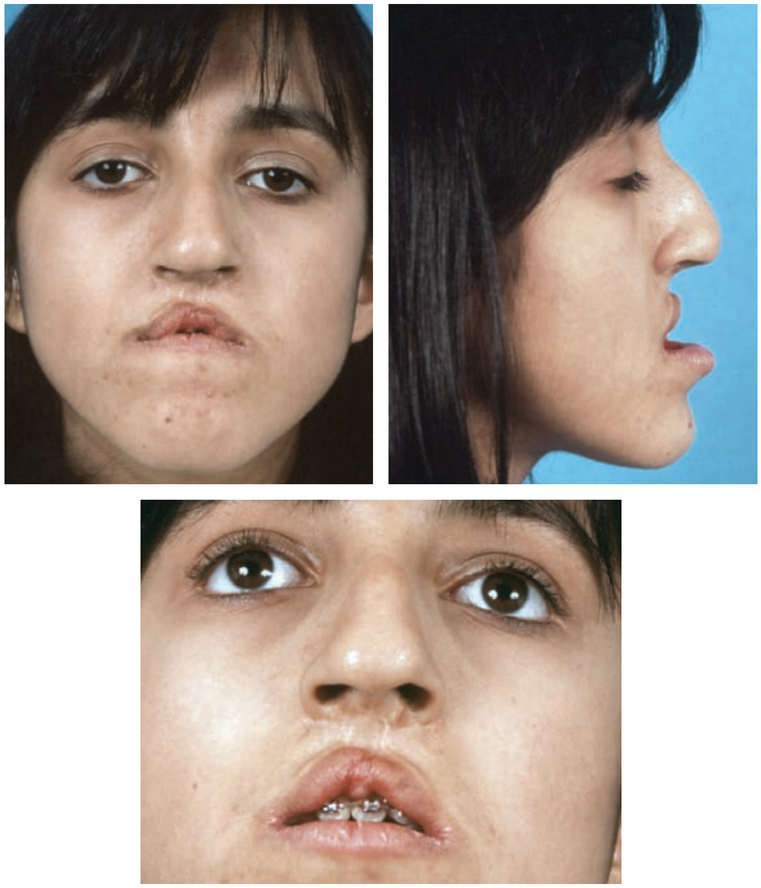


This 45-year-old man had a left unilateral cleft nasal deformity, with characteristic findings of a type II deformity. This includes a malpositioned ala, depressed lateral crura, poor tip projection and septal deviation. His nasal base is broad and his dorsum mildly prominent.



Rib cartilage provided a columellar strut graft. Septal cartilage was used for a left lateral crural strut graft, left alar contour graft, and right spreader graft. Extensive release of the right lower lateral cartilage was performed including dissection/release of the scroll area and lateral crural release at the piriform.

The patient is shown 1 year postoperatively with improved nasal tip definition and projection and alar symmetry. The left alar rim and external nasal valve has improved support.



This 15-year-old girl had the triad of bilateral cleft nasal deformity, maxillary deficiency, and prognathism. Her dorsal hump accentuated her poor tip projection and definition. Her alae were malpositioned inferiorly and posteriorly, and her septum was deviated.

LeFort I advancement created a foundation for the caudal nose, and extensive release was performed of the bilateral lower cartilages. A tenth rib cartilage graft was used as a columellar strut graft. Lateral crural strut grafts and alar contour grafts were fashioned from septal cartilage. Last, bilateral sagittal split osteotomies allowed mandibular setback.

The patient is shown 3 years postoperatively with improved tip definition, tip projection, dorsal aesthetics, and supratip break. Her facial proportions are much more balanced.

KEY POINTS

- The early primary rhinoplasty sets the foundation for definitive rhinoplasty performed in adolescence or adulthood.
- In patients with adequate primary repair, we do not operate on the nose again until the definitive rhinoplasty at the completion of growth.
- The primary repair of the cleft nasal deformity must address four key features associated with the deformity: (1) release of the lateral ala from its abnormal attachment to the piriform aperture, (2) deficiency of the nasal lining, (3) reconstruction of the muscles of the nasal sill, and (4) repositioning of the dome with correction of the caudal rotation of the lower lateral cartilage.
- Secondary rhinoplasty of an adequately repaired cleft nose will consist of standard rhinoplasty techniques.
- A columellar strut graft is also indicated when combining LeFort I advancement with rhinoplasty.
- The cleft-side lower lateral cartilage is not only malpositioned but also hypoplastic, and both of these features must be addressed in the correction.
- The nasal bones are narrowed with lateral osteotomies and medial osteotomies.
- Spreader grafts are used on the concave side of the deviated septum.
- Our indications for a columellar strut graft in the definitive rhinoplasty include inadequate tip projection, dorsal deficiency, collapse or buckling of the lateral crus, an acute columellar-labial angle.
- Rib cartilage is preferred to septal cartilage for use as a columellar strut graft because of its strength. Correction of the tip deformity requires a columellar strut graft to provide tip projection, improve the lateral crus deformity, make the columellar-labial angle more obtuse, and provide a youthful fullness to the central lip.
- Correction of the hypoplastic lower lateral cartilage requires the use of a lateral crural strut graft and alar contour graft.
- Correction of the position of the ala involves release of the lower lateral cartilage from the piriform aperture, V-Y advancement of the nasal lining, reconstruction of the nasal sill, and reconstruction of the external nasal valve.

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Management of the Cocaine Nose

Bahman Guyuron ▪ Paul N. Afrooz

The first epidemic of cocaine abuse in America occurred during the late nineteenth century. Today it is estimated that more than 50 million Americans have used cocaine, 6 million use it on a regular basis, and 50,000 use the drug for the first time each day.[1] Although cocaine can be administered several ways, insufflation (snorting) is the preferred route.[2] In addition to the many adverse neurologic and cardiovascular effects, habitual cocaine use can have disastrous effects on the architecture of the nose. Insufflation of cocaine exposes the nasal mucosa to the intense vasoconstrictive effects of the drug as well as the myriad caustic additives with which it is "cut," or mixed.

Repeated exposure to cocaine initiates a cycle of ischemia, necrosis, and infection that inevitably destroys the nasal architecture.[3]

The adverse effects of cocaine on the nasal tract, which were first reported by Owens[4] in 1912, range from a pinhole perforation to different degrees of mucosal ulceration, destruction of septal cartilage, and in extreme cases, destruction of nasal bone and maxilla. There have been a number of methods proposed to repair the large septal perforations that occur with chronic cocaine abuse. These proposed methods are not entirely beneficial, and in fact, may be more trouble than they are worth.

Classic cocaine-induced nasal defects include alar notching, nasal deviation to the patient's dominant side, an inverted-V deformity, alar collapse, and a foreshortened and retracted nose.

With the use of skin flaps and microvascular techniques, the integrity of the septum as a partition can be restored.[5,6] Although the septum may be restored, nasal airway patency remains essential and must not be overlooked. Because of the inherent thickness of the donor flaps, the current methods used to repair large septal perforations compromise nasal airway patency. In addition, most of the techniques that use skin flaps leave visible scars in the area of the donor site.[5,6] Therefore justification of such a procedure requires careful consideration.

With the use of basic as well as complex principles of reconstructive and aesthetic rhinoplasty, it is possible to correct cocaine-induced nasal defects. Using these principles, relatively normal form and function of the nose can be restored without repairing large septal perforations. However, before one embarks on this type of nasal reconstruction, it is of critical importance to establish that the patient has been cocaine free for at least 3 years and remains committed to abstaining from cocaine use. An attestation by a drug dependency expert will provide much more reliable information in this regard.

By using basic and complex principles of aesthetic and reconstructive rhinoplasty, relatively normal form and function of the nose can be restored without repairing large septal perforations.

BACKGROUND

Cocaine insufflation induces rapid vasoconstriction and subsequent ischemia of the nasal mucosal lining. The repeated episodes of mucosal ischemia eventually lead to mucosal necrosis, thus initiating the climate for infection. Concurrent bacterial infection, necrosis, and further cocaine abuse will exacerbate the damage and cause a chondritis, followed by septal perforation. As the septal perforation expands, it renders the septum incapable of fulfilling its vital role as the supporting structure for the distal two thirds of the nose.[7] Consequently, septal collapse may cause a saddle deformity and an alteration in the alignment of the upper lateral cartilages and dorsal septum with the nasal bones. This creates the appearance of a bony hump on profile. The characteristic collapse of the nasal base will result in the lateral distribution of nasal and perinasal skin, widening the nasolabial angle and exaggerating the nasolabial folds.

Commonly, there are abnormalities of the turbinate ranging from enlargements to complete destruction. Similarly, internal nasal defects can be extensive and are not confined to the septum. Vast internal damage can lead to a foreshortened nose with exposure of the nostrils and an inverted-V deformity. Nasal deviation is related to a more significant degree of damage done to the nostril that is used

more frequently for insufflation of cocaine. This asymmetry is related to the retraction of the nasal lining involving some of the lateral nasal wall and damage to the alar cartilages that consequently pulls the nasal tip to one side. The damaged nostril commonly corresponds to the patient's dominant hand side, because the insufflation device is typically held in the dominant hand and placed in the corresponding nostril. As a result, the alar bases are asymmetrical, and the alae are notched bilaterally, but right-handed patients may exhibit more significant alar notching and deformities on the right side, and left-handed patients may demonstrate more pronounced defects on the left side. The basilar view reveals the alar collapse and columellar shifting to the affected side. Despite the retracted columella, alar notching leads to columellar exposure. Quite often, tip projection is lost, the upper lip is pulled cephalically, and there is a deficiency in the nasal spine.

People with these physical manifestations of cocaine abuse are often the subject of curious stares and questioning, making normal social interaction difficult. Fundamentally sound principles of aesthetic and reconstructive rhinoplasty can restore the form and function of the nose and effectively eliminate the physical stigma of this disconcerting habit of the past.

PREOPERATIVE ASSESSMENT AND PLANNING

Correction of cocaine-related nasal defects is an arduous task requiring an understanding of the patient's psychology, nasal pathology, and the expertise necessary to apply surgical techniques to achieve gratifying results. A thorough and successful analysis of the deformity begins with the prudent assessment of the patient's psychology. Recognizing the patient's reasoning and motivation to undergo surgery is fundamental and, more importantly, establishing their commitment to living cocaine free is an essential part of a successful long-term outcome. Even the most successful outcome can be destroyed by further cocaine use. Therefore it is critical to ensure that the patient has not used cocaine for at least 3 to 4 years and is committed to remaining cocaine free.

Before surgical reconstruction takes place, it is essential to establish that the patient has not used cocaine for at least 3 to 4 years and is committed to abstaining from cocaine use.

All nasal and perinasal defects should be identified in the preoperative assessment. A comprehensive analysis of the entire face should be performed, paying particular attention to the perinasal region to identify any concomitant defects such as collapse of the maxillary wall or palatal defects. Soft tissue cephalometric

analysis of a life-size photograph will facilitate detection of defects and further delineate the intended objective.[8]

External skin replacement of the nasal lining is not necessarily required, even under the most serious conditions. Restoring nasal form does not require the repair of large septal perforations. Ultimately, these patients are very pleased with the surgical outcome.

OPERATIVE TECHNIQUE

To harvest costal cartilage safely and provide a secure airway, the surgical procedure is performed with the patient under general anesthesia.[9] The nose is injected with lidocaine (Xylocaine) containing 1:200,000 epinephrine and packed with a solution of 4% cocaine, if septoplasty is a component of the surgery. After vasoconstriction is achieved, the nose is infiltrated with 1:100,000 epinephrine containing ropivacaine (Naropin) for additional vasoconstriction without systemic effects.

The open technique using a step columellar incision provides sufficient exposure and allows careful dissection of the nasal frame. The caudal frame is preserved as much as possible while the dorsal skin is carefully and meticulously dissected, and the nasal lining is cautiously protected. The skin and muscle flap are carefully dissected up to the glabellar region, freeing the soft tissues adequately to afford sufficient external coverage.

To elongate the nose adequately, the basal nasal frame is mobilized in the caudal direction. If this does not occur with ease, the nasal lining is released further cephalically under the nasal bones. The lining is reattached to the nasal bones to achieve a watertight closure using burr holes to avoid free communication between the nasal cavity and the cartilage-grafted site. Any dorsal bony hump is removed using a rasp. Nasal bone osteotomies are performed only when absolutely necessary. Several times throughout the procedure the area is irrigated copiously with saline solution containing 1 g of a first-generation cephalosporin.

The costal cartilage is harvested using a submammary incision in women; in men, a lower chest wall incision over the sixth rib is preferred. The skin incision is taken down to and through the rectus muscle using electrocautery. Once the fifth rib is exposed, the costochondral junction is identified. The periosteum and the perichondrium are elevated and harvested as a soft tissue graft if needed, and the incision is continued in the medial direction. A piece of costal cartilage is harvested medially to provide ideal length and flatness to restore the dorsal frame. Hemostasis is achieved, and the wound is thoroughly irrigated. A suction drain

is placed in position, and a detailed repair is performed with a combination of 3-0 Vicryl, 5-0 Vicryl, and 5-0 plain catgut. At this point, the dorsum is lowered cephalically and flattened sufficiently to avoid irregularities and dislodgement of the rib cartilage to either side. Using Gibson's principle, the cartilaginous frame is fashioned from the costal cartilage.

Next, a piece of conchal cartilage is harvested from the postauricular area if necessary. The selected ear is infiltrated medially and laterally with lidocaine containing 1:100,000 epinephrine. Using a postauricular incision, the skin is carefully dissected from the conchal cartilage along with the perichondrium. An incision is made in the conchal cartilage, and the cartilage is separated from the perichondrium. The conchal cartilage is harvested encompassing the entire conchal fossa, leaving ample support for the ear frame. After hemostasis is achieved and the wound is irrigated, a suture is brought through the upper portion of the conchal fossa, taken through the mastoid fascia, and brought out through the lower pole using 5-0 plain catgut. The postauricular incision is repaired using running, locked 5-0 plain catgut suture. To remove any dead space, a cotton dressing is applied to the conchal fossa, and the previously placed suture is tied over it.

The medial crura are separated and pulled anteriorly using a pair of double hooks. The domes are advanced equally and aligned appropriately. Using methylene blue and a 25-gauge needle, the columella is then tattooed to mark the medial crura. A dorsal graft is prepared using costal cartilage, if there is a deficit. A groove is created at the caudal end of the dorsal graft to accommodate a columellar strut, which is also fashioned from costal cartilage. A K-wire is placed through the cartilage graft to minimize the potential for warping if needed. The dorsal graft is placed in position and adjusted until an optimal alignment is achieved. Two K-wires are inserted to fix the dorsal graft into position, and the dorsal skin is pulled caudally. Extreme care is used to avoid penetration of the nasal cavity with the K-wires. If the nasal lining is penetrated, bacteria may seed the graft through the pierced nasal lining and initiate a postoperative infection that will jeopardize the meticulous reconstruction. Alternatively, the cartilage graft can be fixed to the underlying bone using a PDS suture being passed though the underlying bone using an 18-gauge needle to make a hole in the bone. The columellar strut is placed between the medial crura and fixed posteriorly to the anterior nasal spine with a 5-0 nylon suture. The strut is fixed in the groove of the dorsal graft.[10]

Alar cartilage is rarely destroyed. If necessary, it is replaced with a piece of conchal cartilage that is sewn to the ipsilateral medial crus–columellar strut composite frame.[11] The medial crura are fixed to the strut if indicated; maxillary grafts are placed in position at this time. A temporary suture is placed in the columellar incision and the K-wires are reinserted as necessary to correct any misalignment.

For the patients who still have some remaining anterior septum, the nose can be elongated using a tongue-and-groove technique described by the senior author.[10]

K-wires or PDS sutures are used for fixation of the costal cartilage graft. Extreme care should be taken to avoid penetrating the nasal lining because this will increase the probability of postoperative infection.

■ ■ ■

Using a columellar strut with rib cartilage and if necessary, conchal cartilage tip graft, tip projection and definition are restored.

■ ■ ■

The nasal frame is elongated using costal cartilage as a dorsal bar or a tongue-and-groove technique.

If a tip graft is necessary, it is prepared from conchal cartilage using the tip graft punch[12] and positioned and fixed using 6-0 Monocryl. Alar rim cartilage grafts are then applied. Alar notching is corrected with a V-type incision extended to the natural junction of the upper and lower lateral cartilages, rather than the usual marginal alar rim incision. The vestibular lining is elevated as a flap for subsequent V-to-Y caudal advancement, thus providing the laxity necessary to correct the alar notch.[11] After a V-to-Y advancement flap, alar rim stents are placed internally and externally, and sewn into position using 5-0 Prolene in a through-and-through technique and tied gently. The columellar incision is repaired, and an Aquaplast (WFR/Aquaplast Corporation, Wyckoff, NJ) dorsal splint is applied and kept in position for approximately 8 days. The K-wires remain in position for 3 weeks. During this time a systemic antibiotic agent is administered prophylactically.

Using conchal cartilage, alar rim grafts are prepared and placed in position to correct the alar concavity.

■ ■ ■

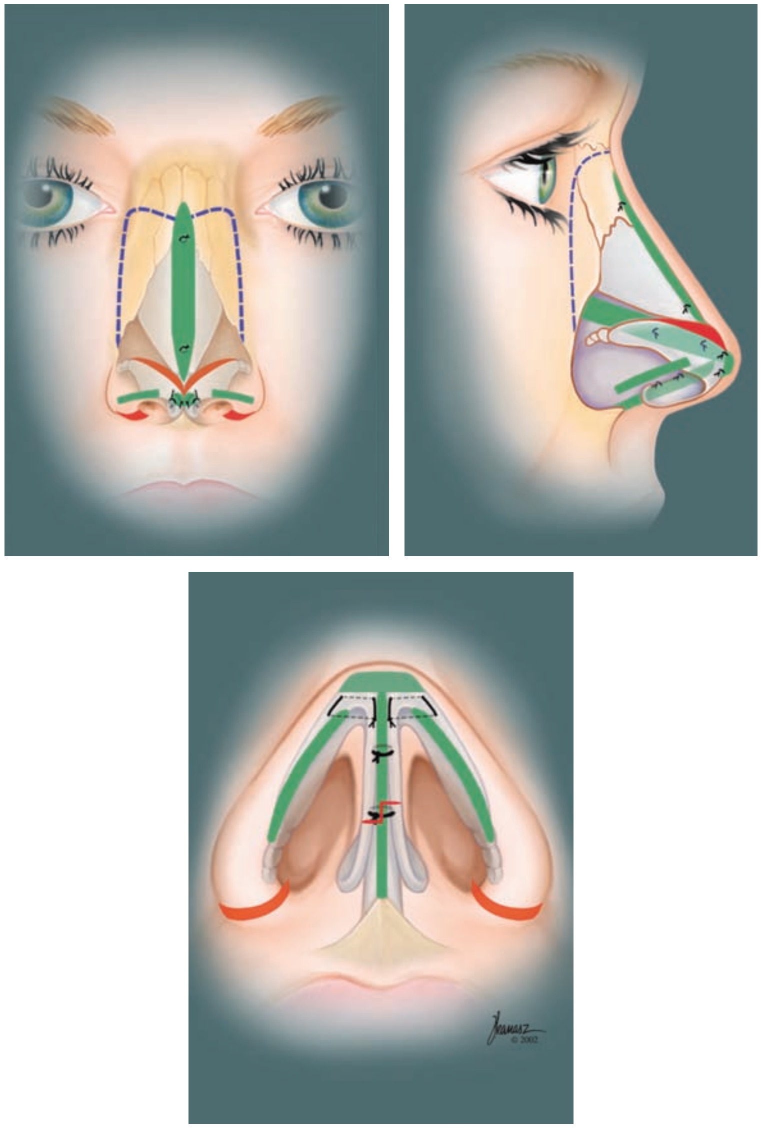
A V-to-Y caudal advancement flap of the nasal lining is used to relieve alar notching.

■ ■ ■

K-wires, if used, remain in place for 3 weeks, during which time patients receive systemic antibiotic agents prophylactically.

CASE ANALYSES

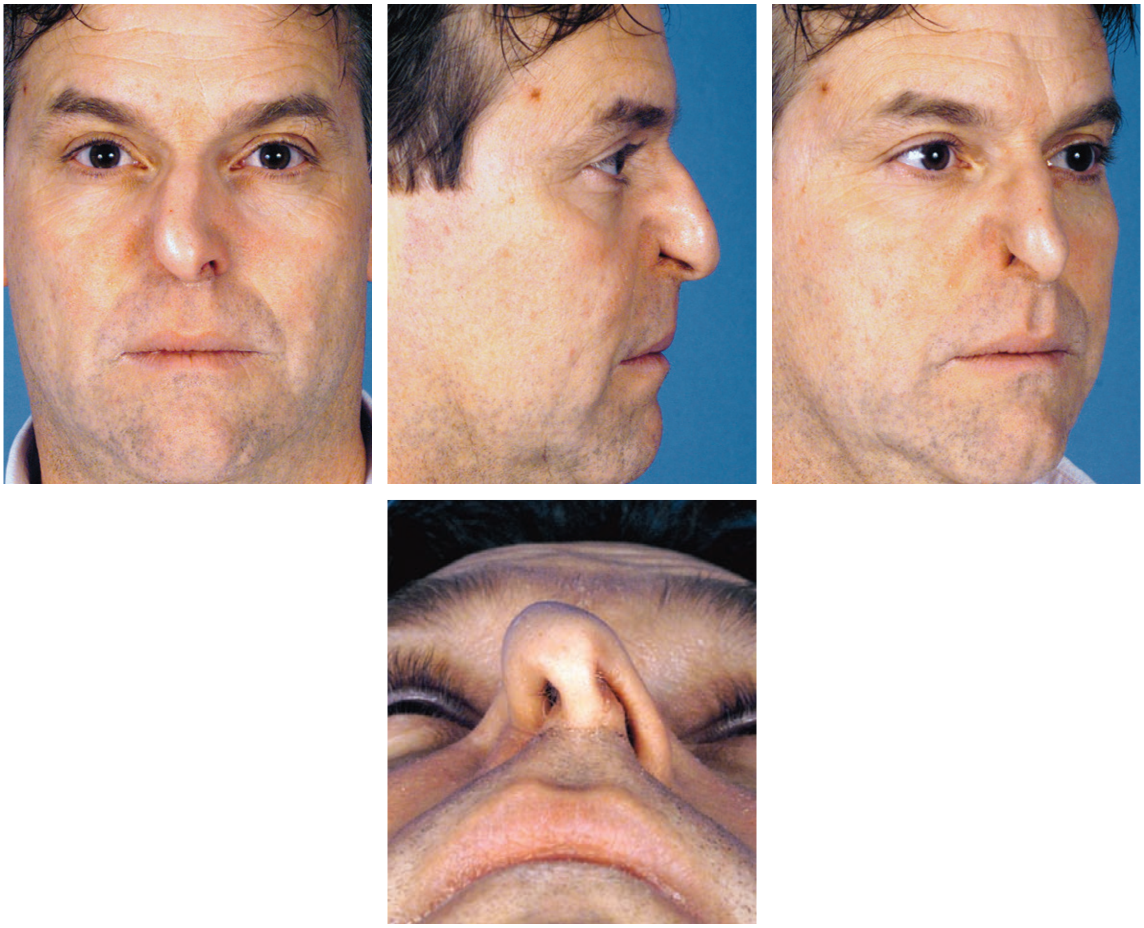
Preoperative photos of this patient demonstrate cocaine-induced deformities: collapse and retraction of the cartilaginous vault creating the appearance of a dorsal bony hump, right alar collapse, tip and columellar deviation, alar notching, columellar show, a widened nasolabial angle, and an exaggerated nasolabial fold.



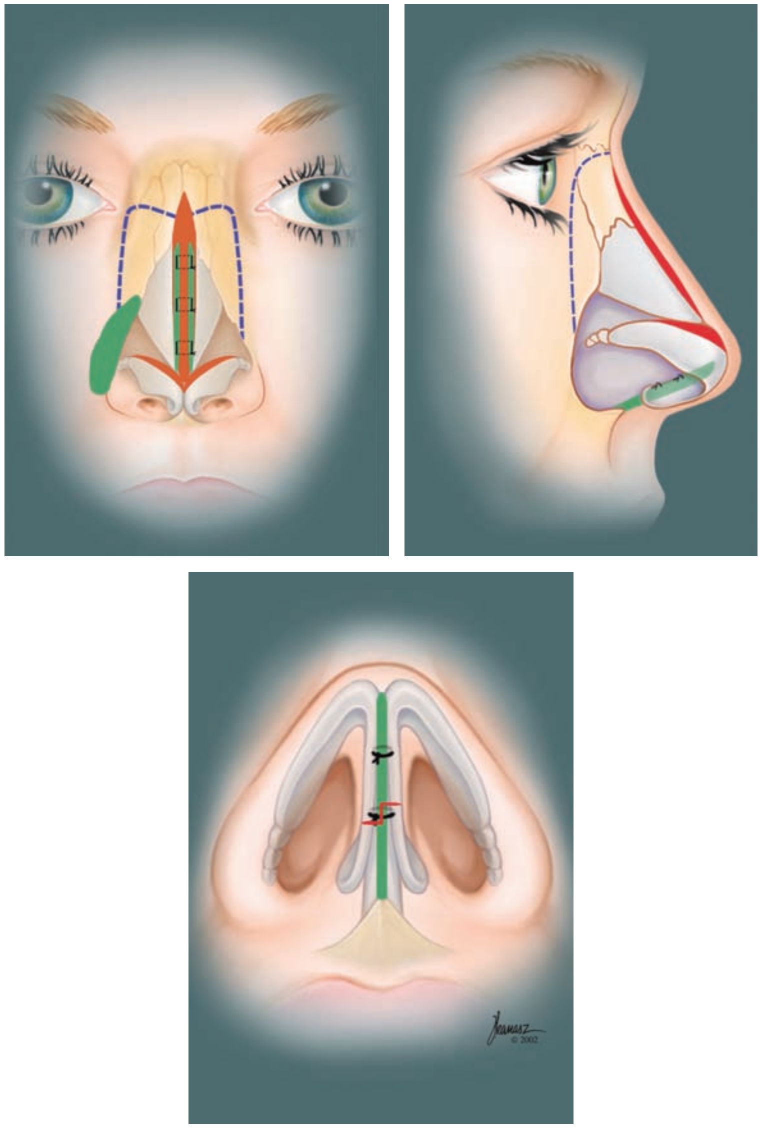
Surgical Plan

1. Perform open rhinoplasty through a stair-step columellar incision.
2. Perform osteotomy.
3. Augment dorsum with dorsal graft.
4. Perform cephalic trim of lower lateral cartilages.
5. Place alar contour grafts.
6. Perform transdomal suture.
7. Place tip cartilage graft.
8. Perform alar wedge resection.
9. Place lateral crural strut.
10. Place columellar strut.

This patient initially had an optimal alignment during surgery. However, she developed a deviation to the left as a result of loss of left alar support. She underwent a second surgery to improve the alignment of her nose and to reconstruct the right alar cartilage. The patient is shown 1 year postoperatively.



This patient is shown before a single-stage nose reconstruction was performed to correct cocaine-related deformity. He demonstrates significant nasal deviation, alar notching, columellar show, and maxillary depression on the right side.



Surgical Plan

1. Perform open rhinoplasty through a step columellar incision.
2. Remove dorsal hump.
3. Place spreader grafts.
4. Perform cephalic trim of lower lateral cartilages.
5. Place conchal cartilage graft to eroded maxilla.
6. Perform osteotomies.
7. Place columellar strut graft.

The patient is shown 10 months postoperatively. This single-stage nose reconstruction demonstrates correction of nasal deviation, alar notching, and maxillary erosion, as well as improvements in dorsal contour, tip definition, and nasolabial angle.

COMPLICATIONS

K-wires in place for 3 weeks after surgery can be a nidus for postoperative infection that can jeopardize the outcome of this reconstruction. Infection is less probable if the nasal lining is not pierced when placing and adjusting the K-wires. Using extreme care when placing the K-wires, along with the prophylactic use of systemic antibiotic agents for 3 weeks postoperatively, can help to prevent this problem.

CONCLUSION

Habitual insufflation of cocaine has the potential to cause an array of nasal defects that can drastically alter the user's appearance. These patients harbor physical signs of their habit that interfere with normal social interaction, which can be quite disconcerting for them. Once these patients are committed to avoiding cocaine use, surgical correction can restore nasal form and function.

Patients who have a history of relapse within the last 3 to 4 years and are not committed to abstaining from cocaine use do not qualify for this surgery, because further abuse will inevitably destroy the reconstruction. Success is multifactorial, requiring a combination of clinical and psychological analysis, proper identification of internal and external nasal defects, and full execution of basic as well as complex principles of aesthetic and reconstructive rhinoplasty.

KEY POINTS

- Repeated exposure to cocaine initiates a cycle of ischemia, necrosis, and infection that inevitably destroys the nasal architecture.
- Classic cocaine-induced nasal defects include alar notching, nasal deviation to the patient's dominant side, an inverted-V deformity, alar collapse, and a foreshortened and retracted nose.
- By using basic and complex principles of aesthetic and reconstructive rhinoplasty, relatively normal form and function of the nose can be restored without repairing large septal perforations.
- Before surgical reconstruction takes place, it is essential to establish that the patient has not used cocaine for at least 3 to 4 years and is committed to abstaining from cocaine use.
- K-wires or PDS sutures are used for fixation of the costal cartilage graft. Extreme care should be taken to avoid penetrating the nasal lining because this will increase the probability of postoperative infection.
- Using a columellar strut with rib cartilage and if necessary, conchal cartilage tip graft, tip projection and definition are restored.

- The nasal frame is elongated using costal cartilage as a dorsal bar or a tongue-and-groove technique.
- Using conchal cartilage, alar rim grafts are prepared and placed in position to correct the alar concavity.
- A V-to-Y caudal advancement flap of the nasal lining is used to relieve alar notching.
- K-wires, if used, remain in place for 3 weeks, during which time patients receive systemic antibiotic agents prophylactically.

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The Role of Soft Tissue Fillers in Rhinoplasty

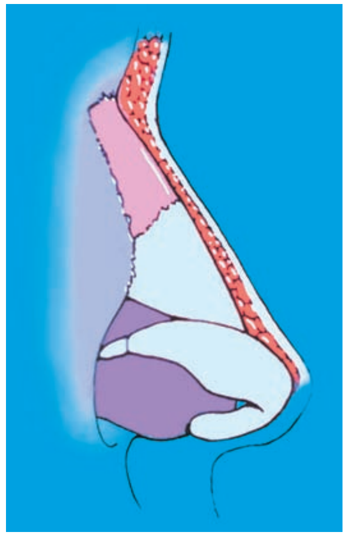
Rod J. Rohrich ▪ T. Jonathan Kurkjian ▪ Jamil Ahmad

Major structural changes of the nose are best accomplished through surgical alteration of the osteocartilaginous framework. However, soft tissue fillers offer an excellent method to augment areas or refine irregularities in certain cases. Often these alterations are subtle and require both precise preinjection nasal analysis and accurate placement of the soft tissue filler to correct the deformities.

Patients with indications for soft tissue filler injections into the nose include the following[1-4]:

- Those who want to "wear" a rhinoplasty before committing to surgery
- Those who do not want to undergo revision surgery to correct a deformity
- Those who are not surgical candidates
- Those who are awaiting the proper interval before undergoing a secondary rhinoplasty

Adapted from Kurkjian TJ, Ahmad J, Rohrich, RJ. Soft tissue fillers in rhinoplasty. Plast Reconstr Surg, 2013 Oct 21. [Epub ahead of print]



As with any rhinoplasty technique, the surgeon must possess knowledge of nasal anatomy to use soft tissue fillers accurately and skillfully. The nature of the nasal skin varies, depending on the anatomic location. In general, the skin is thinner and more mobile proximally and becomes thicker and more immobile distally.[5] This is a critical consideration in the proper application of soft tissue fillers for nasal contouring. The desired level of injection is typically in subdermal layers to maximize effect while avoiding visibility and Tyndall effect. To minimize the risk of intravascular injection, one must consider the subcutaneous location of the nasal vessels superficial to the nasal muscles along with the rich plexus of vessels with contributions from the angular, supraorbital and supratrochlear arteries.[6] High-pressure rapid injections should be avoided, since this has been associated with intravascular injection and emboli to the ocular vessels as well as pressure necrosis.[7-9] This is particularly important in secondary rhinoplasty patients, because altered anatomy, scar tissue, and loss of soft tissue elasticity may increase the risk of these disastrous complications.

High-pressure rapid injections should be avoided, since this has been associated with intravascular injection and emboli to the ocular vessels as well as pressure necrosis. This is particularly important in secondary rhinoplasty patients, because altered anatomy, scar tissue, and loss of soft tissue elasticity may increase the risk of these disastrous complications.

SELECTION OF APPROPRIATE SOFT TISSUE FILLERS

There are many different soft tissue fillers that are available. Soft tissue fillers vary in characteristics, including their composition, consistency, and duration of effect (temporary or permanent). Both availability and approved indications (on label or off label) will vary based on country. Proper selection of soft tissue fillers is based on understanding the variation in constitution and properties between soft tissue fillers.[10]

Proper selection of soft tissue fillers is based on understanding the variation in constitution and properties between soft tissue fillers.

Only hyaluronic acid gel fillers (such as Restylane and Juvéderm) should be employed, as opposed to particulate-based fillers (such as Sculptra and Radiesse), to avoid long-term palpability under the relatively thin nasal skin. The longevity of hyaluronic acid fillers appears to be greater when injected into the nose compared with injection into other areas of the face.[1,2] This longer duration of effect has been the senior author's observation as well with hyaluronic acid fillers, which last up to 2 to 3 years in some parts of the nose. Nonautologous permanent fillers, including liquid silicone, should be avoided, given the long-term complications such as permanent irregularities, infection, granulomas, and chronic inflammation.

Autologous fat grafting is another option to improve nasal contour. Long-term volume filling of the nasal dorsum and sidewalls is better addressed with fat grafting than with nonautologous permanent fillers.

Compared with hyaluronic acids, which can be removed using hyaluronidase or percutaneous needle aspiration if necessary, particulate fillers or permanent fillers are difficult to remove if there is an irregularity that requires correction.

Nonautologous permanent soft tissue fillers should be avoided in the nose.

The surgeon must understand the differences in crosslinking, concentration, and hydrophilicity of each hyaluronic acid product to most effectively treat each anatomic area and deformity. Because of its higher concentration of crosslinked hyaluronic acids and lower hydrophilicity, Restylane is preferred for treatment of the thin skin of the nasal dorsum and side walls. The contour achieved at the time of treatment is less likely to change due to the relatively low potential for Restylane to draw and retain fluid into the treated area. Juvéderm is preferred for the nasal tip and alar rims because it is more easily molded to the desired contour, up to 1 week after injection. When using Juvéderm, however, the injector must consider the potential for postinjection swelling and thus undertreat the area. This additional delayed volume augmentation may be desirable in the patient with the overreduced or thin-skinned nasal tip. If an even thinner and more fluid composition of the hyaluronic acid filler is desired, each 1 ml of hyaluronic acid filler can be mixed with 0.5 ml of 1% lidocaine as an FDA off-label method to reconstitute the product. Newer hyaluronic acid formulations, including Vobella, offer a similar thinner consistency with longer duration of action.

Recommended Soft Tissue Filler for Each Anatomic Region

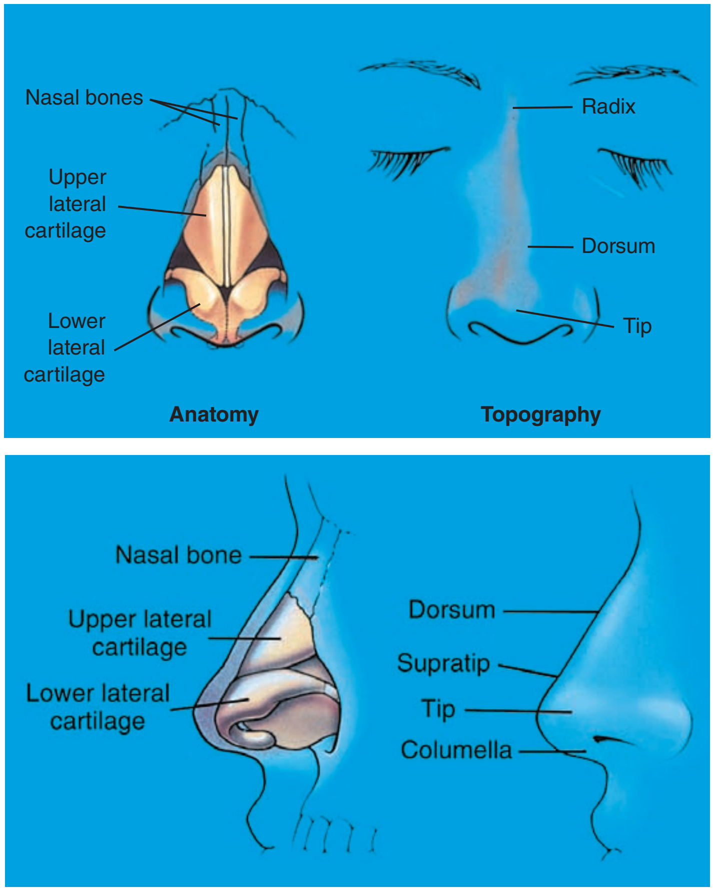
Anatomic Region	Soft Tissue Filler
Dorsum	Restylane
Sidewall	Restylane
Tip	Juvéderm Ultra/Ultra Plus
Ala	Juvéderm Ultra/Ultra Plus

ANESTHESIA

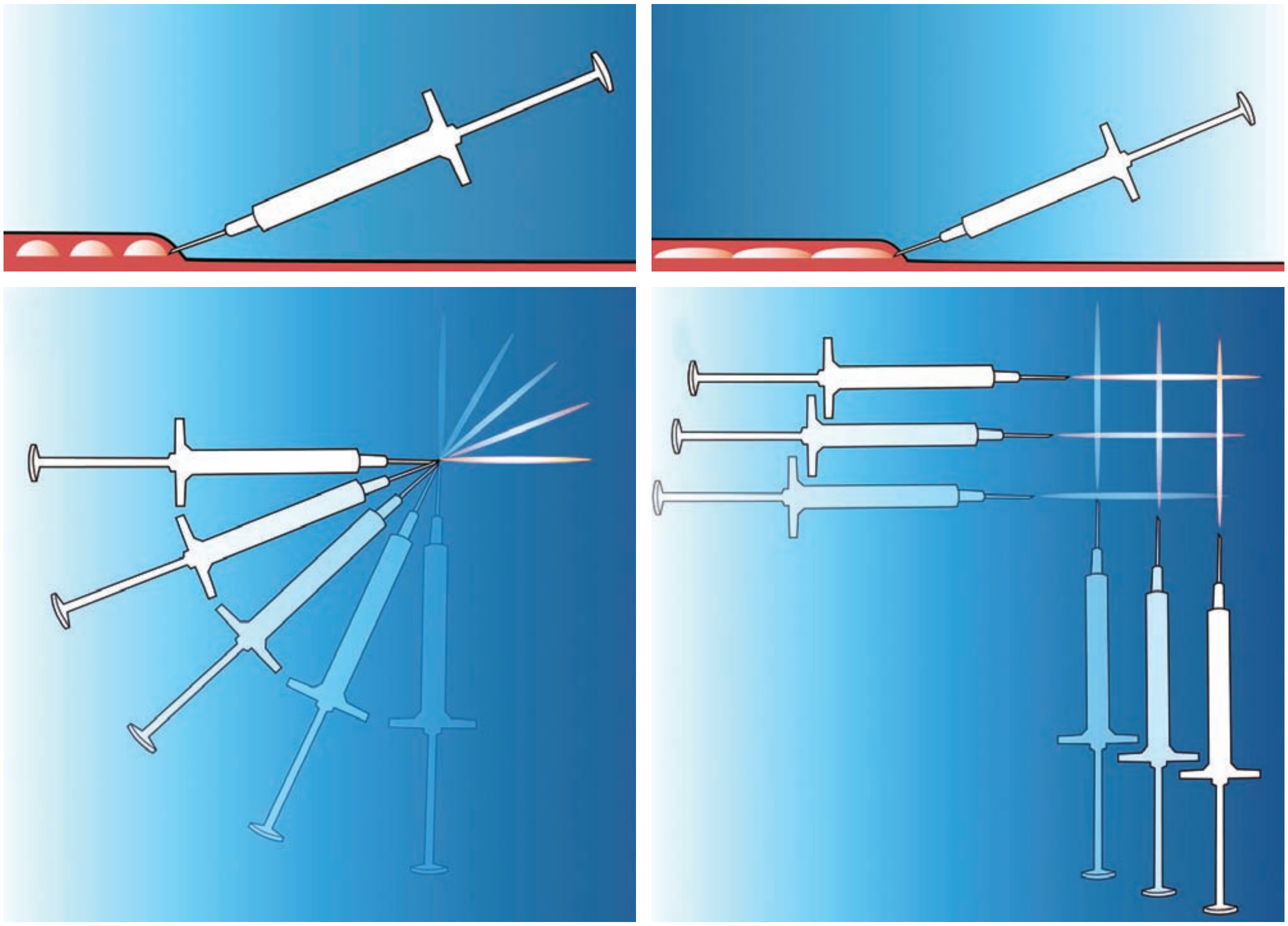
Before treatment with soft tissue fillers, the patient should be anesthetized to maximize comfort. Topical anesthetics are reasonably effective if the appropriate time interval elapses before injection. Various formulations of soft tissue fillers are now available that combine the hyaluronic acid with lidocaine, to deliver a local anesthetic during injection. Alternatively, one can reconstitute 1 ml of hyaluronic acid filler with 0.5 ml of 1% lidocaine. Although using epinephrine in this mixture may help minimize posttreatment bruising and is thought to decrease the risk of intravascular injection, the resultant vasoconstriction will make it impossible to differentiate between epinephrine-induced blanching and actual vascular compromise. Early recognition of vascular compromise is essential to prevent tissue necrosis. Considering the relatively high sensitivity of the nose, a lidocaine block of the maxillary branch of the trigeminal nerve is often indicated to ensure a more comfortable experience for the patient.

Early recognition of vascular compromise is essential to prevent tissue necrosis.

INJECTION TECHNIQUE



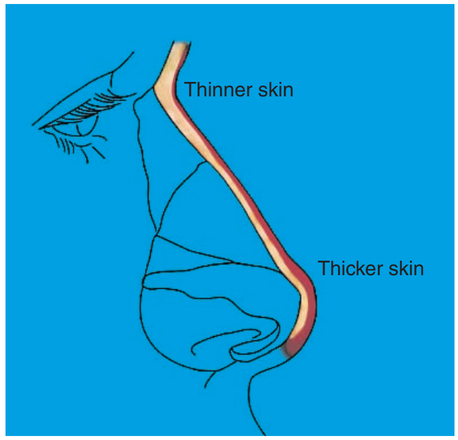
All soft tissue fillers should be injected using the smallest needle possible to maximize control over the volume of injection. In the case of hyaluronic acid fillers, a 30-gauge needle is ideal.[10] In patients who have had previous rhinoplasty, transfer of the hyaluronic acid filler into a BD syringe with a 31-gauge needle allows tremendous control and accuracy in placement of product and helps to limit injection pressures which may reduce the risk of complications. Injection technique will vary based on anatomic location and the goal of treatment.[8]



Injection techniques including serial puncture *(above left)*, linear threading *(above right)*, fanning *(below left)*, and crosshatching/radial *(below right)* may be used.[11,12]

In patients who have had previous rhinoplasty, transfer of the hyaluronic acid filler into a BD syringe with a 31-gauge needle allows tremendous control and accuracy in placement of product and helps to limit injection pressures which may reduce the risk of complications.

Nasal Dorsum



The nasal dorsum is best approached using small amounts of hyaluronic acid filler. As mentioned before, Restylane is the preferred product to use in this area because of its higher level of cross-linking and lower hydrophilicity. After injection, the hyaluronic acid filler should be gently massaged to help with even distribution thus avoiding contour irregularities. After injection, the surgeon should allow 15 minutes to pass to give the soft tissues time to adjust and the product to fully diffuse. This allows for a more accurate assessment of effect prior to further injection. Volume of injection and skin color should be assessed regularly to avoid any compromise of vascular perfusion to the nasal skin. Layering the hyaluronic acid filler from deep to superficial is preferred for volume restoration of the nasal dorsum. A threading technique along the long axis of the nasal dorsum should be employed to maintain proper nasal shape. Voluma is a newer formulation of hyaluronic acid filler with thicker consistency and suitable for volume augmentation when placed in a deep plane along the osteocartilaginous framework. It is subject to postinjection swelling and thus the area should be slightly undertreated. Products with thicker consistency should be avoided in patients with thin skin or decreased soft tissue elasticity after previous rhinoplasty.

Nasal Sidewall

The nasal sidewall is also best addressed using small amounts of hyaluronic acid filler with postinjection massage and a 15 minute delay before reinjection. The skin of the nasal sidewall should also be continually assessed for any evidence of vascular compromise. The preferred method of injection is through a cross-hatching technique to achieve a uniform volume expansion along the flat plane of the nasal sidewall. As mentioned before, Restylane is the preferred product to use under the thin skin of the nasal sidewall.

Nasal Tip and Ala

The use of small amounts of hyaluronic acid filler, postinjection massage and 15 minute delay before reinjection also apply to treatment of the nasal tip. More than any other area, the nasal tip skin must be treated with conservative volumes and constant assessment of skin perfusion to avoid potentially disastrous sequelae of nasal tip skin compromise. Juvéderm has the advantage of its malleability several days after injection allowing it to be massaged and redistributed for treatment of the nasal tip and ala. Considering the aesthetically sensitive contours of the nasal tip and ala, the ability to mold Juvéderm after injection is a benefit for the patient and surgeon. As mentioned previously, Juvéderm is particularly useful for a patient who desires more tip fullness, since it has the potential for postinjection swelling. Alternatively, Restylane can be used in the nasal tip if more control of the final volume augmentation is desired. When injecting Juvéderm or Restylane for the nasal tip and alae, one should inject with a serial puncture technique to maximize precision and accuracy along this aesthetically critical area. Small volumes of hyaluronic acid filler, in the range of 0.1 to 0.2 ml, can result in significant contour improvement in the nasal tip.

More than any other area, the nasal tip skin must be treated with conservative volumes and constant assessment of skin perfusion to avoid potentially disastrous sequelae of nasal tip skin compromise.

SOFT TISSUE FILLERS AFTER RHINOPLASTY

Soft tissue fillers offer a valuable treatment option for patients after rhinoplasty. In some instances, minor irregularities remain following surgery, and patients may not want to undergo revision surgery to correct a deformity. Alternatively, soft tissue fillers can be used to achieve a temporary result in patients who are awaiting the proper time interval before undergoing a secondary rhinoplasty.

Soft tissue fillers can be used to achieve a temporary result in patients who are awaiting the proper time interval before undergoing a secondary rhinoplasty.

Following nasal surgery the presence of scar tissue makes the soft tissue envelope less compliant. Moreover, the blood supply to the nasal tip complex may be altered. These two factors should always be remembered when injecting soft tis-

sue fillers into the nose following rhinoplasty. In these instances, it is even more critical to assess for adequate tissue perfusion during injection as skin necrosis may occur due to both intravascular injection and more commonly, pressure ischemia and necrosis. It may be necessary to inject smaller volumes of soft tissue filler and/or perform staged injections to prevent these complications.

In patients who have had previous rhinoplasty, it may be necessary to inject smaller volumes of soft tissue filler and/or perform staged injections to prevent intravascular injection or pressure necrosis.

Treatment of Possible Vascular Compromise During Hyaluronic Acid Filler Injection

- Stop injection immediately.
- Massage the injection area.
- Inject hyaluronidase: Ratio of 10 units of hyaluronidase per 0.1 ml of hyaluronic acid filler.
- Inject the area of injection and the area distal to the injection site supplied by affected blood vessels.
- Apply topical nitropaste every 8 hours.
- Give aspirin orally.
- Initiate hyperbaric oxygen therapy.

If blanching occurs during injection, the injection should be stopped immediately. If signs of tissue perfusion such as color and capillary refill do not return, hyaluronidase should be injected to degrade the product. Typically, at least 10 units of hyaluronidase should be injected for every 0.1 ml of hyaluronic acid filler that was injected. If tissue perfusion is still abnormal after treatment with hyaluronidase, then oral aspirin and topical nitropaste should be started. Hyperbaric oxygen treatment may also be beneficial. Compromised tissue perfusion following injection of particulate-based fillers such as Sculptra and Radiesse is particularly difficult to treat as hyaluronidase has no effect; this is another reason why use of these fillers should be avoided in the nose.

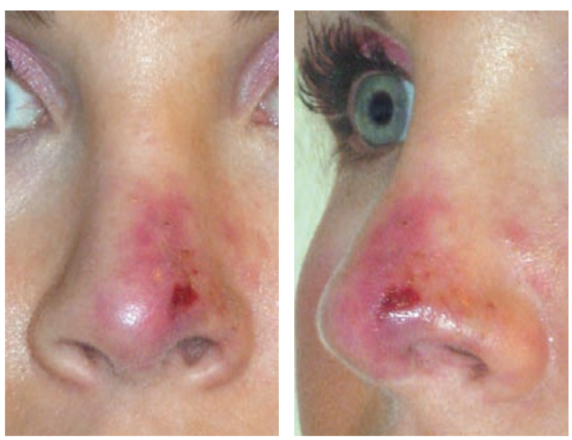
If blanching occurs during injection, the injection should be stopped immediately.

CASE ANALYSES

This 42-year-old woman with asymmetrical dorsal aesthetic lines and a narrow midvault is seen before and after treatment. She received 0.4 ml of Restylane to the left nasal sidewall and 0.1 ml of Restylane to the right nasal sidewall.

This 58-year-old woman presented with a significant dorsal contour deformity. She was treated with 0.7 ml of Restylane to the nasal dorsum.

This 36-year-old woman had asymmetry of the nasal tip, including an irregularity of the right tip–alar junction and an overreduced nasal tip after 8 previous rhinoplasty surgeries.



She was injected with 0.1 ml of Voluma to the right tip–alar junction and 0.2 ml to the supratip and left tip–alar junction. At 6 days after treatment, she began to show signs of tissue necrosis. Three separate injections at 10-minute intervals delivering a total of 30 units of hyaluronidase in 1.5 ml of 2% lidocaine were injected to the nasal tip, alae, dorsum, and sidewalls.

The patient was started on 81 mg aspirin daily, and nitropaste was applied topically every 8 hours. Hyperbaric oxygen treatment was started, and she had a total of 12 sessions.

She is shown at 6 months after the necrosis healed and before the next filler injections.

When healing was complete, 0.1 ml of Refine was injected to the right tip–alar junction and 0.05 ml to the left tip–alar junction over two treatment sessions at 4-week intervals. With the history of multiple nasal surgeries and the resulting changes in the soft tissue characteristics, both the type of product and the volume injected during the session may have contributed to this complication.

KEY POINTS

- High-pressure rapid injections should be avoided, since this has been associated with intravascular injection and emboli to the ocular vessels as well as pressure necrosis. This is particularly important in secondary rhinoplasty patients, because altered anatomy, scar tissue, and loss of soft tissue elasticity may increase the risk of these disastrous complications.
- Proper selection of soft tissue fillers is based on understanding the variation in constitution and properties between soft tissue fillers.
- Nonautologous permanent soft tissue fillers should be avoided in the nose.
- Early recognition of vascular compromise is essential to prevent tissue necrosis.
- In patients who have had previous rhinoplasty, transfer of the hyaluronic acid filler into a BD syringe with a 31-gauge needle allows tremendous control and accuracy in placement of product and helps to limit injection pressures which may reduce the risk of complications.
- More than any other area, the nasal tip skin must be treated with conservative volumes and constant assessment of skin perfusion to avoid potentially disastrous sequelae of nasal tip skin compromise.
- Soft tissue fillers can be used to achieve a temporary result in patients who are awaiting the proper time interval before undergoing a secondary rhinoplasty.
- In patients who have had previous rhinoplasty, it may be necessary to inject smaller volumes of soft tissue filler and/or perform staged injections to prevent intravascular injection or pressure necrosis.
- If blanching occurs during injection, the injection should be stopped immediately.

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Prevention and Management of Rhinoplasty Complications

C. Spencer Cochran ▪ Alan Landecker

In this chapter we will present and analyze the most common complications of rhinoplasty. Complications are classified as hemorrhagic, infectious, traumatic, functional, aesthetic, and miscellaneous. We also describe the most appropriate treatment strategies for each problem.

HEMORRHAGIC COMPLICATIONS

Epistaxis

Postoperative bleeding is one of the most common complications after nasal surgery. Prevention requires identification of the patients at risk. All patients should have a routine preoperative laboratory workup. Those with a personal or family history of bleeding disorders such as platelet dysfunction or von Willebrand's disease should have additional tests, including prothrombin times, activated partial thromboplastin times, and platelet function assays. The use of anticoagulant drugs, aspirin, and NSAIDs should be curtailed beginning at least 2 weeks before surgery.

During surgery, careful dissection, meticulous hemostasis, and precise closure of incisions are paramount. Osteotomies are performed carefully to minimize mucosal injury, and special attention must be given to hemostasis of the turbinates if a resection is performed. Finally, the use of septal splints can reduce the occurrence of bleeding from the septal area because of their compressive and stabilizing effects.

Complications of Nasal Surgery

Category	Complication
Hemorrhagic	Epistaxis Septal hematoma Orbital hemorrhage
Infectious	Infection
Traumatic	Fracture of septal L-strut Intracranial injury and cerebrospinal fluid leakage Anosmia Blindness Dental trauma Epiphora
Functional airway	Internal valve dysfunction External valve dysfunction Septal perforation Persistent septal deviation Sinus obstruction Synechiae Rhinitis
Aesthetic	Dorsal deformities Supratip (pollybeak) deformity Tip deformities Unaesthetic scars Skin necrosis
Miscellaneous	Postrhinoplasty nasal cysts Contact dermatitis Skin telangiectasias Nasal pack aspiration Psychiatric disturbances

Epistaxis can be mild or severe. The mild form is more frequently diagnosed. The most common causes of mild epistaxis are bleeding from incision sites and traumatized mucosa. Mild postoperative bleeding can generally be controlled with 60-degree head elevation, gentle pressure on the nostril or nostrils for 15 minutes, and application of topical decongestant nasal sprays such as oxymetazoline or phenylephrine.

If bleeding persists, the septal splints are removed and the nasal passages gently suctioned to remove blood clots and crusts. Focal areas of bleeding may be cauterized with silver nitrate, or a light hemostatic packing made of Surgicel can be placed over the bleeding surface. Newer topical hemostatic sealants containing thrombin (for example, FloSeal) may alleviate diffuse mucosal bleeding. Con-

tinued bleeding can require a formal nasal pack, either in the form of gauze or a commercially available nasal tampon. Antibiotic agents are given while packing is in place to reduce the risk of toxic shock syndrome (TSS).

Serious bleeding occurs in fewer than 1 of 100 patients and warrants operative exploration when conservative measures are unsuccessful. Persistent bleeding may require endoscopic ligation of the sphenopalatine artery, internal maxillary artery, or anterior and posterior ethmoidal arteries. Bleeding that is refractory to all of these measures can be treated with angiographic embolization.

One of the most recent advances in the control of epistaxis is intravenous DDAVP (desmopressin acetate) to control both intraoperative and postoperative bleeding. Faber et al[1] described the use of intravenous desmopressin for the treatment of excessive postoperative bleeding. Each patient received 0.3 μg/kg of intravenous desmopressin over 30 minutes. Bleeding either stopped completely or slowed down significantly, allowing resolution of symptoms. They did not report any adverse side effects.

Mild postoperative bleeding is generally controlled with 60-degree head elevation, gentle nostril pressure for 15 minutes, and application of topical decongestant nasal sprays such as oxymetazoline or phenylephrine.

Septal Hematoma

A septal hematoma is a potentially serious complication of rhinoplasty. Patients can present with symptoms of nasal obstruction, pain, rhinorrhea, or fever.[2] The typical finding on physical examination is an ecchymotic nasal septal mass. Proper management consists of early recognition, prompt evacuation of the hematoma, and antimicrobial therapy if a secondary nasal septal abscess is suspected.

This patient is shown postoperatively with a septal hematoma. Bilateral expansion of the septum is blocking both nasal airways.

Proper management of a septal hematoma consists of early recognition, prompt evacuation of the hematoma, and antimicrobial therapy if a secondary nasal septal abscess is suspected.

Orbital Hemorrhage

Orbital hemorrhage can result from disruption of blood vessels located behind the orbital septum or from central retinal artery occlusion.[3] Early recognition and prompt ophthalmologic consultation and management are necessary to prevent ocular injury and loss of vision. Medical treatment may include an intravenous bolus of 20% mannitol (1 to 2 g/kg over 30 to 60 minutes), 100 mg of methylprednisolone (Solu-Medrol), and 500 mg of acetazolamide. Any decrease in visual acuity requires surgical decompression. Examples of the most commonly employed techniques are lateral canthotomy, orbital decompression through an external ethmoidectomy or transantral approach, and lateral orbitotomy.

Prompt recognition and management of orbital hemorrhage is necessary to prevent ocular injury and loss of vision.

INFECTIOUS COMPLICATIONS

Postoperative infections after rhinoplasty represent a spectrum of infectious processes. These infections range in severity from mild cellulitis of the soft tissue envelope to life-threatening systemic illness resulting from cavernous sinus thrombosis or TSS. Rhinoplasty surgeons should be diligent in examining patients for signs of infection and initiating treatment early.

Postoperative infections after rhinoplasty range in severity from mild cellulitis of the soft tissue envelope to life-threatening systemic illness resulting from cavernous sinus thrombosis or TSS.

Local wound infections such as cellulitis can be treated with systemic antibiotic agents and close observation; however, a suspected abscess requires prompt surgical drainage and antibiotic therapy. Common sites of abscess formation after rhinoplasty include the nasal dorsum, nasal tip, and septum.

A septal abscess usually arises in the setting of an infected septal hematoma that is unrecognized or inadequately treated. Septal abscesses have serious implications and can lead to cartilage necrosis with subsequent loss of dorsal support and a saddlenose deformity.

Treatment of a septal abscess begins with incision and drainage. Packing the abscess site with gauze may aid in local wound debridement and provide a means of egress for residual infection. Generally, patients should be given intravenous antibiotics until the infection is controlled. Cavernous sinus thrombosis, meningitis, or a brain abscess can result without adequate treatment.

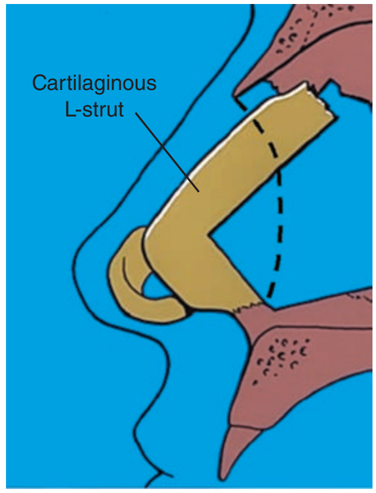
Septal abscesses can lead to cartilage necrosis with subsequent loss of dorsal support and a saddlenose deformity. Treatment of a septal abscess begins with incision and drainage and adequate antibiotic therapy.

TSS, an acute multisystem disease, has been described as a sequela of nasal surgery with both nasal packing and intranasal splints.[4,5] It is usually caused by the release of an exotoxin, TSS toxin-1, created by *Staphylococcus aureus.* The exotoxin acts as a superantigen that causes the activation of leukocytes with a resultant massive release of proinflammatory cytokines. Symptoms occur early and can include nausea or vomiting, rash, fever, tachycardia, and hypotension. Treatment requires immediate removal of the offending object, ICU admission, intravenous antibiotic therapy, and supportive care.

Routine prophylactic administration of antibiotic agents in rhinoplasty remains controversial. Nevertheless, topical and systemic antibiotic agents are frequently given in the perioperative and postoperative periods. In a survey of plastic surgeons, Perrotti et al[6] found that 72% of respondents gave antibiotics during or after rhinoplasty, and the use of perioperative antibiotics in rhinoplasty patients has decreased by 200% between 1985 and 2000.[7] Despite their widespread use and apparent efficacy, no clear guidelines exist in the literature regarding antibiotic therapy in aesthetic surgery. Frequently cited rationales for antibiotic prophylaxis in rhinoplasty patients are the use of intranasal splints and the fear stemming from reports of TSS, the clean-contaminated nature of surgical wounds, and the use of grafts. Topical antibiotic ointment significantly decreases the growth of potentially infectious nasal flora, including *S. aureus,* in patients with nasal packing.[8]

TRAUMATIC COMPLICATIONS

L-Strut Fractures



The area where the septal cartilage joins the perpendicular plate of the ethmoid is a particularly vulnerable region where overresection or disruption during rhinoplasty leads to potential collapse of the dorsum and a saddlenose deformity.[9] Fracture of the nasal septal L-strut with separation at the osteocartilaginous junction is shown above. For septal cartilage harvest, most authors recommend preservation of a 1 cm wide L-strut that remains attached to the perpendicular plate of the ethmoid and nasal spine–maxillary crest area. L-strut fractures should be repaired immediately to prevent significant deformity, because the cartilaginous septal segment tends to rock posteriorly to cause a loss of dorsal support.

Fractures of the midportion of the dorsal septal L-strut can be stabilized using suture techniques and spreader grafts, provided that exposure of the fracture is adequate and cartilage cephalad to the fracture site is sufficient for suturing the spreader grafts. When the fracture occurs cephalad to the nasal bone edges, the fractured L-strut can be rigidly fixated using percutaneous K-wires placed through the nasal bones and fractured dorsal septum caudal to the fracture site.[10] For fractures that occur near or at the nasal bone edges, a combination of spreader grafts and K-wires is required, because suture placement above this area is precluded by the tight anatomic relationships. Placement of the K-wires through the nasal bones rather than through the upper lateral cartilages allows rigid fixation of the fractured segment. K-wires are left in place for 3 to 4 weeks and removed in the office with a wire twister.

L-strut fractures should be repaired immediately to prevent collapse of the dorsum and a saddlenose deformity. Stabilization is obtained using suture techniques, spreader grafts, or percutaneous K-wires.

Intracranial Injury and Cerebrospinal Fluid Leakage

Intracranial injury and cerebrospinal fluid (CSF) leaks are a major complication after rhinoplasty. Violation of the cribriform plate by surgical instruments can cause a CSF leak and potential intracranial injury or infection. A fractured cribriform plate can result from excessive bony septum manipulation. Symptoms of CSF leakage include clear rhinorrhea and positional headache. The diagnosis is confirmed by testing the CSF for the presence of beta2-transferrin, a protein highly specific for CSF. A CSF leak necessitates hospitalization, bed rest, and prompt otolaryngologic and neurosurgical evaluations, with potential placement of a lumbar drain. Surgical repair with endoscopic techniques may be required for persistent leakage despite conservative measures.

Intracranial injury and CSF leaks are a major complication after rhinoplasty and result from violation of the cribriform plate. Treatment includes hospitalization, bed rest, and prompt otolaryngologic and neurosurgical evaluations.

Anosmia

Anosmia after rhinoplasty is an uncommon complication. The sense of smell depends on nasal airflow. Therefore anything that decreases nasal airflow postoperatively (for example, splints or packing and edema) can diminish or destroy the sense of smell. Treatment is often expectant; however, persistent symptoms warrant an otolaryngologic evaluation to rule out an undiagnosed neoplastic process or iatrogenic injury to the cribriform plate and olfactory groove.

Anosmia after rhinoplasty is frequently transient. Persistent symptoms warrant an otolaryngologic evaluation to rule out an undiagnosed neoplastic process or iatrogenic injury to the cribriform plate and olfactory groove.

Maxilla Fracture After Inferior Turbinate Outfracture

Inferior turbinate hypertrophy is a common component of nasal obstruction, and therapeutic outfracture often is used as an ancillary procedure in rhinoplasty. Excessive lateral movement of the inferior turbinate during outfracturing can violate the thin medial maxillary wall and push the turbinate into the maxillary sinus. Patients may present with symptoms of sinusitis from a blocked maxillary sinus osteum, or epiphora from injury to the nasolacrimal duct as it courses through the medial maxilla.

This is a coronal CT scan image of a patient who had prior turbinate outfracture. It shows a characteristic displacement of the right medial maxillary wall *(arrow)* and sinus opacification. The fractured maxillary segment disrupts normal mucociliary flow, impairing drainage from the maxillary sinus osteum.

Excessive lateral movement of the inferior turbinate during outfracturing can violate the thin medial maxillary wall and push the turbinate into the maxillary sinus.

Blindness

Blindness after rhinoplasty is extremely rare. Most reports involve the injection of steroids into the nasal turbinates (resulting in emboli to the central retinal artery) and vascular spasm after anesthetic injection to the septum and turbinates.[11] However, Shafir et al[12] presented a case of unilateral blindness after subcutane-

ous steroid injection into scarred tissue of the nasal dorsum. This complication is prevented by thorough knowledge of the anatomy, preinjection application of a topical vasoconstrictor, and the use of caution when injecting steroids and anesthetics into the nasal structures.

A thorough knowledge of the anatomy and the use of caution when injecting steroids and anesthetic agents into the nose help to prevent complications such as blindness.

Dental Trauma

Dental complications of nasal surgery are rare and generally occur from injury to the neurovascular supply of the teeth, leading to discoloration or devitalization. Injury can be caused by intubation trauma or during surgery as a result of bony manipulation near the nasal spine. Anatomic factors that increase the risk of this complication include an aberrant vascular supply or a root apex situated high in the premaxilla. The treatment of choice includes endodontic therapy and cosmetic dentistry techniques.

Dental complications generally occur because of injury to the neurovascular supply of the teeth. Treatment includes endodontic therapy and cosmetic dentistry techniques.

Epiphora

Epiphora after rhinoplasty can result from compression of the lacrimal system by the characteristic soft tissue postsurgical edema. This normally resolves after 1 to 2 weeks. Bleeding epiphora and lacrimal sac injury have been reported during straight-line or saw nasal osteotomies after subperiosteal tunneling. However, recent studies using active transport dacryocystography demonstrate that low lateral osteotomies are a safe technique to prevent injury to the lacrimal drainage system.[13] Treatment of these injuries may require early silicone intubation of the lacrimal system or dacryocystorhinostomy.

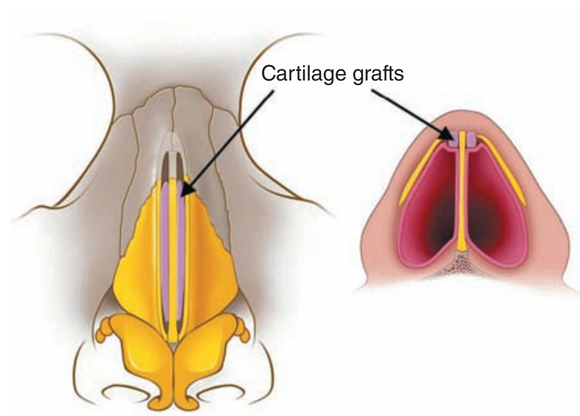
Epiphora after rhinoplasty is most frequently caused by postoperative edema that compresses the lacrimal system.

FUNCTIONAL COMPLICATIONS

Internal Valve Dysfunction

Injury and destabilization of the keystone area (the junction between the upper lateral cartilages and the nasal bones) may result in collapse of the internal nasal valve (the angle formed at the junction of the upper lateral cartilage and the septum) and subsequent nasal airway obstruction. This typically occurs when the upper lateral cartilages are overresected during dorsal reduction and is more common in patients with short nasal bones. The resulting loss of medial support of the upper lateral cartilages typically leads to inferomedial collapse and is manifested externally as the inverted-V deformity and internally as cicatricial narrowing of the internal nasal valve angle and impaired airflow.

Injury and destabilization of the keystone area (the junction between the upper lateral cartilages and the nasal bones) may result in collapse of the internal nasal valve and subsequent nasal airway obstruction.



Various techniques have been described to treat internal valve dysfunction. These include auricular cartilage grafts placed transversely over the nasal dorsum and sutured to the upper lateral cartilages, and suture techniques that span the dorsal septum and connect the upper lateral cartilages. However, the most significant contribution to the prevention and correction of internal valve dysfunction is Sheen's spreader grafts. Spreader grafts are longitudinal grafts placed between the dorsal septum border and the medial edges of the upper lateral cartilages in a submucoperichondrial pocket, as shown above.[14] This placement results in lateralization of the upper lateral cartilage, thereby increasing the cross-sectional

area of the internal nasal valve and maximizing airflow. Spreader grafts can be used to straighten a high dorsally deviated septum, improve the dorsal aesthetic lines, and reconstruct an open roof deformity. Septal cartilage is the preferred graft source, and the length and shape vary depending on the indication. The grafts are suture-fixated to the septum before reapproximation of the upper lateral cartilages to the septum–spreader graft complex.

Spreader grafts are rectangular cartilage grafts placed between the dorsal septal border and the medial edges of the upper lateral cartilages. This placement results in lateralization of the upper lateral cartilages, widening of the nasal valve angle (increasing its cross-sectional area), and an increase of airflow through the internal valve.

If internal nasal valve collapse is severe, support of the lateral nasal wall between the internal nasal valve and the external nasal valve may also be required. This site of collapse normally corresponds to the site of previously overresected lateral crura. In these cases, lateral crural strut grafts or alar batten grafts can be used with spreader grafts and are placed at the site of maximal lateral wall collapse.

The placement of dorsal onlay grafts may also improve internal valve dysfunction by exerting an upward and lateralizing force on the dorsal nasal skin. Because the skin is attached to the upper lateral cartilages, this force is transmitted to the upper lateral cartilages and results in widening of the internal valve angle.

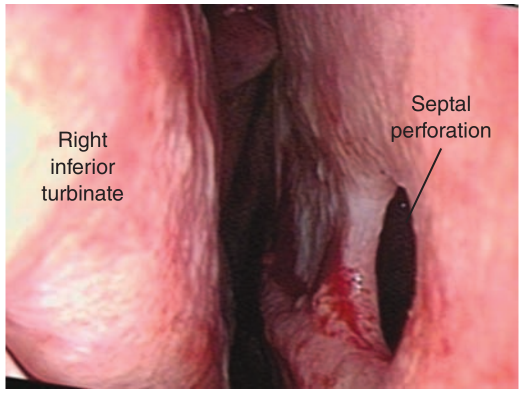
External Valve Dysfunction

External valve dysfunction is caused by medial (inward) displacement of the alar rims and therefore a decrease of its cross-sectional area during inspiration. This problem generally occurs because of structural weakness of the alar rims from overresection of the lower lateral cartilages. The basic treatment principle for this problem is reinforcement of the supporting system of the alar rims with cartilage or sutures. Improved support results in lateralization of the alar rims and an increased cross-sectional area across the external nasal valve. Various techniques and approaches have been proposed in the literature and are described throughout this book, including lateral crural strut grafts, alar spreader grafts, alar contour grafts, suture techniques, repositioning of the lateral crura, alar batten grafts, cephalic trim grafts, composite grafts, alar base flaps, and anchor grafts. Prosthetic devices are a nonsurgical alternative to provide symptomatic relief.

External valve dysfunction is caused by medial (inward) displacement of the alar rims resulting from structural weakness. This problem is generally caused by overresection of the lower lateral cartilages. Reinforcement of the supporting system of the alar rims with cartilage or sutures lateralizes the alar rims and increases the cross-sectional area across the valve.

Nostril stenosis is another cause of external valve dysfunction and may result from abnormal scarring, infection, or inaccurate coaptation of the vestibular skin during closure. This photo shows nostril stenosis in a patient who had three prior rhinoplasties. Correction of this problem should include release of the scar tissue and placement of grafts or flaps to ensure long-term maintenance of the external valve. An effective example is the alar base flap, which is designed as a crescent adjacent to the alar base and based on subcutaneous and musculocutaneous perforators. This technique allows simultaneous repositioning of the alar base if displacement is present. Auricular composite grafting may also be used for this purpose. In this technique, the composite graft is harvested from the cymba concha and can be placed coronally, sagittally, or axially along the intranasal alar rims. A slightly larger graft than the defect is harvested to compensate for secondary graft contracture. Although favorable results have been described in the literature, graft take can be jeopardized in these patients because of the invariably scarred recipient site. The same concern applies to the use of simple skin grafts in this area. Finally, prosthetic support can be helpful to counteract recurrent scarring and narrowing of the valve in the postoperative period. Progressive expansion before surgery with expandable prosthetic devices to enlarge the stenotic opening and aid in surgical stabilization of the opening has shown some promise but is in trial stages.[15]

Septal Perforation



Nasal septal perforations after septorhinoplasty are most often caused by opposing tears in the elevated septal mucoperichondrial flaps with no intervening septal cartilage. This is an endoscopic view of a septal perforation after a septoplasty. Alternatively, perforations may occur after significant interruption of blood flow to the septal mucoperichondrial flaps from an unrecognized septal hematoma or tissue necrosis from septal stitches. Symptoms of a nasal septal perforation include crusting, bleeding, pain, whistling, and nasal airway obstruction. Patients can present with symptoms of nasal obstruction, because the perforation disrupts the normal laminar airflow through the nasal passages. These symptoms are often dictated by the size and location of the perforation. Anterior or caudal septal perforations are more problematic.

Symptom severity should guide the decisions for treatment. Conservative measures include local hygiene with nasal saline solution irrigation, or obturation with a silastic septal button. For small perforations, local advancement flaps with an interposed connective tissue autograft or an allograft can be performed to close the perforation. Larger perforations are more challenging and may require more extensive exposure and tissue for successful closure.

Nasal septal perforations after septorhinoplasty are most often caused by opposing tears in the elevated septal mucoperichondrial flaps with no intervening septal cartilage, significant interruption of septal blood flow, an unrecognized septal hematoma, or tissue necrosis from septal stitches.

Intranasal Adhesions and Persistent Septal Deviation

Synechiae are intranasal adhesions that result from cicatricial healing of opposed, abraded mucosal surfaces. Patients may present with nasal obstruction. Intranasal examination will reveal a bridge of mucosa from the septum to the inferior or middle turbinate. Treatment requires division and placement of a barrier such as a silastic splint between the incised surfaces until the surfaces undergo complete reepithelialization.

The need for and optimal means of internal splinting of the septum have been debated considerably over the last several decades. Although most surgeons do not routinely pack the nose, Guyuron[16] found that patients in whom nasal packs were used were less likely to develop recurrent or residual septal deviation and synechiae, compared with patients in whom no packing was used. He later demonstrated that nasal airway improvements with septal splints were similar to improvements after packing.[17] Conversely, several studies have demonstrated that paired silicon splints may not prevent adhesions and can add to postoperative discomfort.[18,19]

Nevertheless, intranasal splints are routinely used to help maintain septal stability and prevent intranasal adhesions after septorhinoplasty. The general consensus is that when placed bilaterally, septal splints help to stabilize the septum as the mucoperichondrium readheres and may help to prevent the formation of a septal hematoma. It is likely that adhesions form only across abraded mucosal surfaces not protected by the splints, or if the splints are removed too early. Splints are generally left in place for 48 hours to 7 days, but this is controversial.

Persistent septal deviation after septorhinoplasty is a source of frustration for both the patient and the surgeon. Residual deviation of the septum can result from inadequate surgical techniques, unpredicted forces of healing, or insufficient septal stabilization during the immediate postoperative period. Significant septal deviation that persists and causes cosmetic or functional impairment may require revision surgery.

Sinus Obstruction

Obstruction of the maxillary and ethmoid sinus ostea can result from inadvertent lateralization of the middle turbinate, persistent septal deviation, or an unrecognized pneumatized middle turbinate, referred to as a *concha bullosa.* Other factors that may contribute to symptoms of rhinosinusitis after rhinoplasty include congenitally small osteomeatal openings and mucosal hypertrophy related to

inflammatory disease processes of the nose such as chronic rhinosinusitis, nasal polyposis, and allergic rhinitis. CT imaging and an otolaryngologic evaluation may be warranted for patients who have symptoms of sinus obstruction after rhinoplasty.

Rhinitis

Atrophic rhinitis can be caused by overresection of intranasal structures such as the middle or inferior turbinate. It can lead to atrophy of the nasal mucosa with subsequent symptoms of dryness, crusting, and nasal obstruction. The use of nasal saline solution may provide symptomatic relief.

After rhinoplasty some patients develop postrhinoplasty rhinitis. They may have nasal obstruction despite adequate surgical management of the septum and nasal valves. Beekhuis[20] reported a 10% incidence of symptomatic nasal obstruction in his series of rhinoplasty patients. Treatment is often expectant, but oral decongestants, topical nasal steroid sprays, and irrigation with a nasal saline solution may be helpful.

More commonly patients report a spontaneous, clear, watery nasal discharge. This phenomenon most likely represents a variant of vasomotor rhinitis caused by abnormal parasympathetic tone to the intranasal mucosa.[21] Topical anticholinergic preparations such as 0.03% ipratropium bromide act locally and are effective in decreasing watery rhinorrhea. The recommended dosing regimen is two sprays in each nostril two to three times a day as needed. Continued symptoms of watery nasal discharge despite appropriate topical therapy should raise concern for an occult CSF leak.

AESTHETIC COMPLICATIONS

Dorsal Deformities

Dorsal deformities are among the common causes of revision rhinoplasty. They may be caused by overresection or underresection of the osteocartilaginous framework, asymmetrical resections, bony fragments left between the framework and the skin after dorsal hump reduction, incorrect shaping of grafts and their edges, and migration of grafts as a result of insufficient or inaccurate fixation.

In our hands, dorsal reduction is more accurately performed using open rhinoplasty techniques with direct visualization of the dorsum, which helps to prevent overreductions, underreductions, and asymmetrical reductions. After resection of the excess cartilage from the septum and upper lateral cartilages, reduction

of the bony dorsum is more safely performed using rasps. If osteotomes are employed, they must be extremely sharp and used to cut the bone rather than as a wedge, with the fracturing of the bone occurring distal to the leading edge of the osteotome.

The osteotome should also be angled so that less bone is removed than necessary. This angle aids in preventing excess reduction, which is often difficult to correct. Final shaping can then be carried out using a rasp or drill.

When both medial and lateral osteotomies are performed, it is important to prevent complete mobilization of the nasal bones, which results in a loss of support and possible collapse of the bony segments, with resultant depressions that may be very difficult to correct. Finally, the nose should be thoroughly irrigated before closure to remove loose fragments of cartilage or bone. These fragments are typically generated when nasal bones are rasped and excess cartilage is shaved from the septum or upper lateral cartilages. If left inside the nose, these tissues can cause palpable or visible dorsal irregularities during the late postoperative period.

Persistent dorsal deformities are generally not treated until at least 1 year after the previous rhinoplasty. Exceptions to this rule are patients who present with significant deformities in the early postoperative period. If the deformity is obvious and will likely cause the patient considerable emotional distress during the healing period, then revision is considered. If early intervention is needed, the patient is informed that another operation may be required if other deformities become apparent after the swelling has subsided.

Dorsal deformities caused by underresection of the osteocartilaginous framework can be corrected by careful resection of the excess bone or cartilage during revision rhinoplasty. Patients with deformities caused by grafts that have migrated or have become visible after swelling has subsided may require removal of the graft, complementary shaping of its edges, and reinsertion. If dorsal deformities caused by overresection are present, cartilage from the septum, rib, and ear (rarely) can be harvested and shaped according to the techniques presented throughout this book. Although some authors have reported satisfactory results using alloplastic implants such as Gore-Tex, silicone, and hydroxyapatite, autologous material is preferred because it carries a decreased risk of infection and extrusion. Successful results have also been reported using Surgicel or temporalis fascia–wrapped diced autologous cartilage.

Autologous cartilage is the preferred material for reconstruction of the nasal framework because it carries a decreased risk of infection and extrusion.

Supratip (Pollybeak) Deformity

Supratip fullness, commonly referred to as a *pollybeak deformity,* is a postoperative complication of rhinoplasty in which the nasal supratip assumes a convex shape in relation to the nasal dorsum. A pollybeak most often results from either inadequate resection of the lower dorsal septum and upper lateral cartilages or from overresection of these supratip structures with subsequent scar tissue formation in the resulting dead space. Loss of tip projection in the presence of adequate septal angle height may also cause this deformity.

The supratip pollybeak deformity is a postoperative complication of rhinoplasty in which the nasal supratip has a convex shape in relation to the nasal dorsum.

Prevention of the supratip deformity primarily involves establishing an appropriate relationship between the dorsal height and tip projection. Ideally the differential level between the tip-defining points and the septal angle will be approximately 6 to 8 mm, depending on the thickness of the skin. This distance normally ensures an aesthetically pleasing contour at the transition between the dorsum and the tip. Once the adequate differential is obtained, the goal is to eliminate all dead space between the underlying framework and the skin. This step is important to prevent the accumulation of blood and the resulting fibrosis with fullness. This complication can usually be controlled with taping, but if the skin is not draping onto the area as desired, a fast-absorbing (4-0 plain gut) suture can be placed through the deep dermis in the supratip area and septal angle. The suture is tied to close the dead space and ensure that no dimpling of the skin surface occurs.

Patients who develop supratip fullness postoperatively should be instructed to apply compressive tape onto the supratip area overnight, beginning 2 to 5 weeks postoperatively or anytime thereafter when the surgeon thinks that the supratip break is not developing as it should. This measure is generally effective, because swelling and scar tissue formation are the causal factors of supratip fullness in most patients. Tape with an elastic component (Blenderm; 3M, Minneapolis, MN) may provide improved compression compared with conventional tape. Taping is discontinued when a permanent depression is noted. If the tape causes irritation of the skin, it should be discontinued and hydrocortisone cream applied three times a day until irritation resolves.

Steroid injections may be helpful to control excessive swelling or scar tissue in the supratip area in patients who have a deformity despite conservative treatment. Triamcinolone acetate (10 mg/ml) is mixed with 1% lidocaine at a 1:1 ratio. This

preparation is injected into the supratip area using a syringe with a fine needle. It is important to inject the preparation into the deeper layers just above the framework and not intradermally to prevent atrophic skin complications. The most frequently used volumes deliver approximately 1 to 2 mg of triamcinolone to the area per injection, which can be repeated at 2-month intervals. Slightly higher doses may be used depending on the clinical scenario. Although the clinical response to steroids is variable, an aesthetically pleasing supratip contour is usually obtained in most patients whose sculpting of the cartilaginous framework was performed correctly.

In patients who develop supratip fullness postoperatively, compressive taping of the supratip area should be initiated during the first month after surgery. This is generally effective, because swelling and scar tissue formation are the causal factors in most patients if surgery was performed correctly. If conservative treatment is unsuccessful, steroid injections may be helpful to control the production of excessive scar tissue in the supratip area.

The most frequent side effect of steroid injections is dermal atrophy, which can lead to a contraction deformity of the skin. Treatment includes the use of retinoic acid and other similar products. Other side effects are telangiectasias, depressions, color changes, and eventual visibility of the underlying cartilages or contour imperfections, which may be enhanced by the resulting decreased skin thickness. In patients who do not respond to conservative treatment and in those with underlying anatomic causes, surgery is not performed until at least 1 year after the initial procedure. The basic principles include judicious removal of the offending cartilage or scar tissue, adjustment of the osteocartilaginous framework so that the differential between the midvault and the tip is adequate, elimination of dead space by establishing direct contact between the underlying framework and the skin, and application of a dressing with selective compression over the supratip area.

If supratip fullness is caused by an overprojected caudal dorsum, the excess cartilage should be resected and the remaining structures positioned adequately. If the tip is underprojected, grafts such as columellar struts, shield grafts, and onlay grafts may be necessary.

Surgery should not be performed for pollybeak deformities until at least 1 year after the initial procedure in patients with underlying anatomic causes and in patients who do not respond to compressive taping or steroid injections.

Tip Deformities

The most common tip deformities after rhinoplasty are depressions, irregularities, asymmetries, and collapse of the alar rims. They may be caused by excessive or asymmetrical resections of the lower lateral cartilages, inaccurate alignment of the domes (tip-defining points), proliferation of scar tissue between the cartilaginous framework and the skin, and the placement of tip grafts that tend to become visible over time as skin thins. Correct sculpting of the lower lateral cartilages can be distorted by the unpredictable forces of scar contraction that occur after surgery. Poor surgical planning and execution can create a tip that is overprojected or underprojected in relation to the height of the dorsum.

Adherence to some important principles during the primary rhinoplasty may prevent the previously mentioned problems. The increased exposure offered by an open rhinoplasty approach allows surgeons to assess and sculpt the lower lateral cartilages under direct vision. A columellar strut is used to stabilize the tip and serves as a foundation for tip shaping. The strut is also useful because the domes (tip-defining points) are fixated with sutures to the strut's anterior end during the final tip shaping, which may help to resist the forces of scar contraction after surgery. To prevent the formation of visible or palpable irregularities between the tip-defining points, this maneuver needs to be performed with the domes and the anterior end of the strut at the same horizontal level. Before closure, the surgeon should look for signs of alar rim weakness. If the basal view demonstrates signs of alar rim collapse, grafts such as alar contour grafts or lateral crural strut grafts may be inserted. To prevent long-term visibility, the edges of many types of grafts placed over the tip-defining points can be morselized.

In general, tip deformities should only be corrected at least 1 year after the previous rhinoplasty. Some patients require even more time (2 to 3 years) for postoperative edema of the tip to resolve entirely and allow precise analysis of the deformity. These deformities are more easily corrected through an open rhinoplasty approach.

Major nasal tip deformities are more easily corrected through an open rhinoplasty approach, because the increased exposure facilitates a precise diagnosis of the deformity, accurate shaping of the remaining cartilages, precise placement of grafts when necessary, and secure fixation of grafts and lower lateral cartilages.

Unaesthetic Scars

Columellar scar problems after external rhinoplasty include widening of the scar, visible depressions, pigmentation changes, and notching along the columellar rim. These complications are relatively rare. The few studies in the literature that analyzed the outcomes of these scars demonstrated that 78% to 95% of patients are satisfied with their columellar scar.[22]

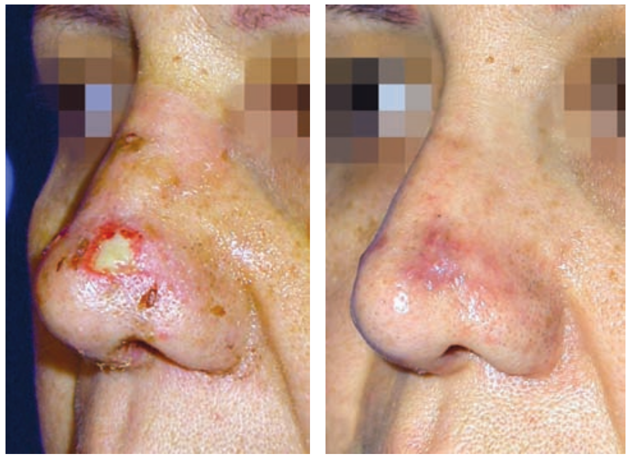
In our experience, adherence to some important technical principles results in a scar that is level, thin, and virtually imperceptible at conversational distances. The incision should be placed on the columella at the point where the medial crural footplates start to flare. This location generally represents the narrowest point of the columella. The incision should be broken to prevent postoperative distortion of the columella resulting from scar contracture. The most frequently used designs are the inverted Chevron and stair-step incisions. When the skin is incised, the scalpel should not be beveled. The incision is made perpendicular to the skin to prevent healing problems such as a trapdoor deformity. During closure, atraumatic handling of the tissues and precise alignment of the edges are fundamental. The most important point of closure is at the junction of the transcolumellar incision and the vertical columellar rim incision. If the alignment at this point is not perfect, notching may occur. Precise closure of the transcolumellar incision is facilitated by cross-hatching or tattooing of the incision site before the skin is incised. Although some authors advocate the use of deep sutures to relieve tension (multilayered closure), we have found this to be unnecessary. The sutures are removed after 5 to 7 days. In patients with unsatisfactory scars, scar revision is generally straightforward and can be performed with the use of local anesthesia.

If precise plastic surgery principles are followed during closure of the columellar incision, the scar is virtually imperceptible at conversational distances in most open rhinoplasty patients.

Skin Necrosis

Injury to the blood supply of the skin during rhinoplasty can cause skin necrosis. In open rhinoplasty, examples include erroneous dissection of the skin flap, injury to the lateral nasal arteries, aggressive debulking of the subcutaneous tissue of the tip, and excessive compression of the skin by taping and dressing. Although no studies have been performed, smokers are assumed to be at higher risk.

Erroneous dissection of the skin flap, injury to the lateral nasal arteries, aggressive debulking of the tip, and excessive compression of the skin by taping and dressing can cause skin necrosis after rhinoplasty.



This patient developed skin necrosis of the nasal tip after open secondary rhinoplasty. On the right, the patient is shown 8 weeks postoperatively, after the tip skin has healed by secondary intention.

Dissection of the skin flap is always performed as close as possible to the osteocartilaginous framework of the nose to preserve most of the blood and lymphatic vessels, which run within or superficial to the superficial musculoaponeurotic system of the nose. Excessively superficial dissections may result in skin necrosis from injury of these vessels and the subdermal plexus. Secondary rhinoplasty patients with previous alar base resections that extend above the alar groove should be treated with caution, because the lateral nasal arteries may have been injured previously. The tip is debulked, if indicated, with extreme caution because of the risk of injury to the subdermal plexus of the skin. It should only be performed conservatively and by more experienced surgeons. Care is required to prevent excessive compression of the skin by the dressing needs.

The treatment of minor skin necrosis is initially conservative. Diligent daily wound care and protection from the sun are required until the wound is closed. Dermabrasion, filler substances, skin care, and laser treatment may be helpful after the scar is mature. In select patients, a skin or composite graft can improve the contour of the affected aesthetic unit. Major skin necrosis is extremely rare and is reconstructed with local or regional flaps.

MISCELLANEOUS COMPLICATIONS

Postrhinoplasty Nasal Cysts

Nasal cysts are a rare complication after rhinoplasty. Several forms of nasal cyst have been described. Lipogranulomas or paraffinomas are foreign body inclusion cysts thought to arise from the use of petroleum-based ointments in conjunction with nasal packing.[23] Mucous cysts are a second type of nasal cyst that can occur after rhinoplasty. The most common site of occurrence for both types of cyst is the nasal dorsum, and they are thought to arise from ectopic or displaced mucosa and ointment extravasation into osteotomy sites.[24] Mucous cysts and lipogranulomas may require complete excision, often in the setting of a secondary rhinoplasty via an open approach to allow adequate exposure. Meticulous closure of intranasal incisions and judicious use of non-petroleum-based antibiotic creams help to decrease the chance of lipogranuloma formation.

Meticulous closure of intranasal incisions and judicious use of non-petroleum-based antibiotic creams help to decrease the formation of postrhinoplasty nasal cysts.

Contact Dermatitis

Contact dermatitis can result from skin irritation by topical adhesives, tape, or dorsal splints. Treatment includes removal of the offending agent and application of topical and possibly systemic steroids.

Contact dermatitis is treated by removal of the offending agent and application of topical and possibly systemic steroids.

Telangiectasias

Telangiectasias are small, visible, superficial vessels of the skin that usually measure 0.1 to 1.0 mm in diameter.[25] Although telangiectasias of the nose have been reported to result from rhinoplasty,[26-28] their incidence after surgery is unknown. Rees[29] has commented that most facial telangiectasias occurring after plastic surgical procedures were present preoperatively and exacerbated by surgery. Several others have advocated that telangiectasias after rhinoplasty result from a failure to dissect in a subperiosteal plane on the nasal dorsum. Other causes of nasal telangiectasias include significant dorsal augmentation in patients with contracted soft

tissue envelopes and alloplastic augmentation with Silastic or Gore-Tex. Whether new or exacerbated, telangiectasias of the nasal skin after rhinoplasty are a frustrating problem for both the patient and the surgeon.

Lasers are a proven effective means of treatment, but they have drawbacks. The use of an argon laser carries a risk of scarring and a relatively high risk of post-treatment pigmentary changes.[30] The pulsed dye laser (585 and 577 nm) is safe and highly effective in combating telangiectasias. It has a short pulse duration (0.45 ms) that reduces the risk of severe, long-term adverse effects. The high cost and decreased availability of this laser limit its use, which often leads to vessel disruption and visible purpura that can last for weeks.

Nasal Pack Aspiration

Nasal pack or septal splint aspiration after rhinoplasty results from posterior displacement of the offending object into the nasopharynx. These patients are at risk for aspiration or ingestion. When the pack or splint is not visible in the anterior nose at the follow-up examination, nasal endoscopy is needed to confirm the presence or absence of the object. This complication can be prevented by careful suturing of the splint or packing to the membranous septum.

Careful suturing of a nasal pack or splint to the membranous septum at the end of a rhinoplasty procedure can prevent aspiration.

Psychiatric Disturbances

Proper screening to identify patients with psychological instability or psychiatric disturbances such as body dysmorphic disorder (BDD) is an important part of preoperative evaluations and can reveal patients who may be more prone to postoperative dissatisfaction. Identification of these patients is not always straightforward and depends on a careful evaluation by both the surgeon and the staff. Common behavioral traits exhibited by such patients include excessive attention to minimal defects, an inability to define the change desired from rhinoplasty, and an inability to establish a good relationship with the surgeon. Some patients have depression or anxiety disorders and are more preoccupied with or analyze their nose more frequently. They tend to have multiple concerns about their body, may be handicapped in their relationships, and may avoid social situations because of their nose. These patients often believe that dramatic changes will occur in their life after a rhinoplasty. Patients who are considered poor candidates because of their psychological status should not undergo surgery.

Emotionally unstable patients are not always recognized before surgery because of the limited time of interaction with the physician and staff. Psychiatric support may be necessary to help manage these patients if symptoms worsen postoperatively.

Psychiatric support may be necessary to help manage psychologically unstable patients after rhinoplasty.

CONCLUSION

Meticulous attention to detail in the operating room and in the postoperative period is paramount to achieving success in rhinoplasty. Nevertheless, both complications and suboptimal results occur, even for experienced surgeons. A thorough knowledge of the principles of postoperative management of these complications can minimize their deleterious effects and preserve an aesthetic outcome.

KEY POINTS

- Mild postoperative bleeding can generally be controlled with 60-degree head elevation, gentle nostril pressure for 15 minutes, and application of topical decongestant nasal sprays such as oxymetazoline or phenylephrine.
- Proper management of a septal hematoma consists of early recognition, prompt evacuation of the hematoma, and antimicrobial therapy if a secondary nasal septal abscess is suspected.
- Prompt recognition and management of orbital hemorrhage is necessary to prevent ocular injury and loss of vision.
- Postoperative infections following rhinoplasty range in severity from mild cellulitis of the soft tissue envelope to life-threatening systemic illness resulting from cavernous sinus thrombosis or TSS.
- Septal abscesses can lead to cartilage necrosis with subsequent loss of dorsal support and a saddle-nose deformity. Treatment of a septal abscess begins with incision and drainage and adequate antibiotic therapy.
- L-strut fractures should be repaired immediately to prevent collapse of the dorsum and a saddle-nose deformity. Stabilization is obtained using suture techniques, spreader grafts, or percutaneous K-wires.
- Intracranial injury and CSF leaks are a major complication after rhinoplasty and result from violation of the cribriform plate. Treatment includes hospitalization, bed rest, and prompt otolaryngologic and neurosurgical evaluations.
- Anosmia after rhinoplasty is frequently transient. Persistent symptoms warrant an otolaryngologic evaluation to rule out an undiagnosed neoplastic process or iatrogenic injury to the cribriform plate and olfactory groove.

- Excessive lateral movement of the inferior turbinate during outfracturing can violate the thin medial maxillary wall and push the turbinate into the maxillary sinus.
- A thorough knowledge of the anatomy and the use of caution when injecting steroids and anesthetic agents into the nose help to prevent complications such as blindness.
- Dental complications generally occur as a result of injury to the neurovascular supply of the teeth. Treatment includes endodontic therapy and cosmetic dentistry techniques.
- Epiphora after rhinoplasty is most frequently caused by postoperative edema that compresses the lacrimal system.
- Injury and destabilization of the keystone area (the junction between the upper lateral cartilages and the nasal bones) may result in collapse of the internal nasal valve and subsequent nasal airway obstruction.
- Spreader grafts are rectangular cartilage grafts placed between the dorsal septum border and the medial edges of the upper lateral cartilages. This placement results in lateralization of the upper lateral cartilages, widening of the nasal valve angle (increasing its cross-sectional area), and an increase of airflow through the internal valve.
- External valve dysfunction is caused by medial (inward) displacement of the alar rims resulting from structural weakness. This problem is generally caused by overresection of the lower lateral cartilages. Reinforcement of the supporting system of the alar rims with cartilage or sutures lateralizes the alar rims and increases the cross-sectional area across the valve.
- Nasal septal perforations after septorhinoplasty are most often caused by opposing tears in the elevated septal mucoperichondrial flaps with no intervening septal cartilage, significant interruption of septal blood flow, an unrecognized septal hematoma, or tissue necrosis from septal stitches.
- Autologous cartilage is the preferred material for reconstruction of the nasal framework because it carries a decreased risk of infection and extrusion.
- The supratip pollybeak deformity is a postoperative complication of rhinoplasty in which the nasal supratip has a convex shape in relation to the nasal dorsum.
- In patients who develop supratip fullness postoperatively, compressive taping of the supratip area should be initiated during the first month after surgery. This is generally effective, because swelling and scar tissue formation are the causal factors in most patients if surgery was performed correctly. If conservative treatment is unsuccessful, steroid injections may be helpful to control the production of excessive scar tissue in the supratip area.
- Surgery should not be performed for pollybeak deformities until at least 1 year after the initial procedure in patients with underlying anatomic causes and in patients who do not respond to compressive taping or steroid injections.

- Major nasal tip deformities are more easily corrected through an open rhinoplasty approach, because the increased exposure facilitates a precise diagnosis of the deformity, accurate shaping of the remaining cartilages, precise placement of grafts when necessary, and secure fixation of grafts and lower lateral cartilages.
- If precise plastic surgery principles are followed during closure of the columellar incision, the scar is virtually imperceptible at conversational distances in most open rhinoplasty patients.
- Erroneous dissection of the skin flap, injury to the lateral nasal arteries, aggressive debulking of the tip, and excessive compression of the skin by taping and dressing can cause skin necrosis after rhinoplasty.
- Meticulous closure of intranasal incisions and judicious use of non-petroleum-based antibiotic creams help to decrease the formation of postrhinoplasty nasal cysts.
- Contact dermatitis is treated by removal of the offending agent and application of topical and possibly systemic steroids.
- Careful suturing of a nasal pack or splint to the membranous septum at the end of a rhinoplasty procedure can prevent aspiration.
- Psychiatric support may be necessary to help manage psychologically unstable patients after rhinoplasty.

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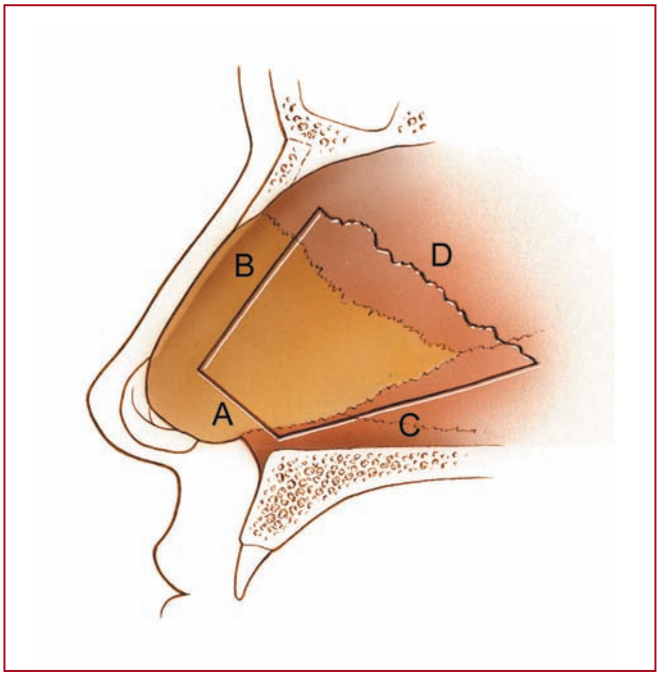
PART ELEVEN

Personal Approaches and Philosophies



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Gunter's Approach

Jack P. Gunter

Rhinoplasty has been a passion for me since I first began my career. It is the most difficult cosmetic surgery procedure to perform with consistently predictable and reproducible results. I have found accurate diagnosis to be the critical cornerstone on which all subsequent planning and execution rely. I have also found that I do better technically with increased surgical exposure. Consequently the open approach has become central to my technique.

After making an accurate diagnosis, a surgeon must be able to determine the cause of the deformity before establishing the goals of surgery and devising an operative plan. With the correct goals and operative plan, it should be relatively straightforward to reconstruct a framework that will produce the desired aesthetic result, provided that the surgeon understands the anatomy of the osteocartilaginous framework and its effect on the external appearance of the nose, obtains adequate exposure for operating, and has the required equipment and materials. The unknown variable, however, is postoperative healing. Currently we cannot adequately stabilize the osteocartilaginous framework to resist displacement and/or distortion by swelling and scar tissue contraction, but good planning and precise execution help to minimize these unpredictable postoperative changes.

To obtain consistently good results, rhinoplasty surgeons must be well versed in nasal anatomy and experts in facial and nasal analysis. Expertise gained by watching others operate and performing rhinoplasty procedures on a regular basis is invaluable. Good record keeping is essential for tracking progress; surgeons must keep accurate operative notes (I prefer pictorial) that can be studied when patients return to learn which techniques are most successful and reliable.

Standardized preoperative and postoperative photographs are needed to evaluate the aesthetic results. Once proficiency is obtained, skills are further refined by teaching rhinoplasty techniques to colleagues.

Publishing and presenting papers at meetings have forced me to reexamine my thinking and have furthered my own education as much as it has for the intended audience, if not more.

PATIENT CONSULTATION

A patient's initial call to the office is critical to establishing good patient rapport and obtaining a successful rhinoplasty result. Each patient's questions should be answered in a friendly, yet professional manner that is informative and conveys an eagerness to help. The patient is then sent pertinent but brief information about the office, staff, surgeon, operative procedure in question, and what to expect at the first consultation.

At consultation, after being greeted by a friendly, helpful front-office staff member, the patient is seen by a nurse who obtains the personal and health history. I prefer the nurse to leave before I see the patient so that we can talk privately. After a brief introduction and small talk to put the patient at ease, I review the pertinent information to be certain I understand the patient's problem and expectations to determine if they are realistic. The examination includes a complete facial and nasal analysis (see Chapter 6) and an endonasal examination using a nasal speculum, adequate lighting (preferably a headlight), and vasoconstriction, if indicated.

After making a diagnosis and determining the cause, I talk to the patient about the goals of surgery. Because I am not facile in computer imaging, I trace on cephalometric paper taped over standardized photographs what I think the goals of the surgery should be. The patient should always be advised that the images produced are used to establish goals only and do not guarantee results. I explain that the results will be close to those drawn but probably will not be exactly the same. If the patient seems unrealistic about what can be achieved, I prefer not to operate rather than have an unhappy patient after surgery.

The patient then talks to the patient coordinator about scheduling the procedure, the cost of surgery, and payment. The patient coordinator must be familiar with all aspects of the surgery so that she can answer the patient's questions knowledgeably. She should be very positive about the procedure and make the patient feel comfortable about scheduling the surgery. When surgery is scheduled, a nominal fee is required to ensure that the patient is committed to proceed. Although I do not use them, some offices make follow-up phone calls and

send letters to patients after the consultation, which is probably a good idea for new surgeons.

Each surgeon must develop a comfortable protocol for patient consultation, but the importance of the initial phone call, the consultation itself, and the evaluation and preoperative patient management cannot be overemphasized.

BASIC PRINCIPLES

The following principles have helped me to develop my personal technique:

- Obtain adequate exposure. To obtain adequate exposure it is generally necessary for me to use an open approach. This allows me to visualize the deformity undistorted by traction and to use both hands while operating under binocular vision, and provides more options for employing different surgical maneuvers. The disadvantages of the open approach are (1) the transcolumellar scar, although it is seldom a problem if sutured correctly; (2) increased operating time to reconstruct and stabilize the osteocartilaginous framework before closing and to close the columella incision properly; (3) more postoperative edema, which requires time to resolve, than with a closed approach; and (4) a more difficult correction if an unsightly columellar scar occurs.
- Resect minimal amounts of tissue. Overresection of cartilage results in a weakness that is more easily distorted by scar tissue contraction. To those who ask, "What is the minimal width to leave a lateral crural rim strip?" my standard answer is, "It should be kept as wide as possible without compromising the aesthetic result." Underresection is usually easier to correct than overresection.
- Maintain a balance between the osteocartilaginous framework and the skin sleeve. An aesthetically sculpted nose is obtained by fitting skin tightly over a well-constructed osteocartilaginous framework. Because skin will only shrink so much, if the framework is too small, the skin will not fit tightly around it and will have little sculpting effect. Too much of an imbalance will result in a deformity. The adage "You can make a No. 3 size nose out of a No. 4 nose, but you cannot make a No. 2" is based on this principle.
- Use original tissues for reconstruction. No other cartilage in the body can simulate the delicate cartilages of the nasal tip. When the original cartilages can be employed to shape the tip framework, I can think of very little justification for using cartilage from other areas other than to help stabilize or shore up the original cartilages.
- Do not use visible grafts if possible. Visible grafts are those that touch the undersurface of the skin and contribute to the shape in that area. Examples are tip grafts, including onlay, umbrella, and shield shape, and dorsal

onlay grafts. Examples of invisible grafts are dorsal spreader grafts, alar spreader grafts, lateral crural strut grafts, and most columellar struts. With age, nasal skin gets thinner, and visible grafts sometimes show through the skin, presenting an unnatural appearance. However, at times they may be the only choice available, and surgeons should be well versed in their use.

- Secure all grafts in place. I have always found it difficult to fashion an undermined pocket the exact size and shape to hold a graft in the desired position. I find it much easier to suture these grafts in place, which is facilitated with the open approach. An example is dorsal spreader grafts.
- When I placed them in pockets dissected using the closed approach, the pockets were either too large, allowing them to fall below the level of the dorsal septum, or too small, forcing the dorsal edge higher than the septum and resulting in a dorsal ridge. With the open approach they can be sutured directly to the septum at exactly the correct level without concern that they will become displaced.
- Stabilize the osteocartilaginous framework as much as possible. Stabilization of the reconstructed framework protects against displacement and distortion caused by edema and scar tissue contraction. This is especially necessary with a open approach, which usually involves more extensive dissection than a closed approach and disrupts more of the supporting elements of the nose.
- Do not quit until the nose looks as good as possible. I tell all my patients that I have never performed a perfect rhinoplasty. Some imperfection always persists when healing is complete. Therefore I never guarantee a perfect result, but I do tell each patient that I will not leave the operating room until his or her nose looks as good as I can make it. A surgeon's best chance of getting an excellent result is on the first try. Because a revision is usually more difficult, the surgeon should not leave the operating room until he or she is satisfied that the nasal shape is as good as possible.
- Shape the nose with the dressing. I believe the dressing is important, because it can be used to shape the nose to some extent. For example, when a short nose is lengthened without the use of grafts, the dressing should be placed with the nose in the lengthened position. If the dressing is placed so that it rotates the nose upward, it will more than likely stay rotated, but it definitely will not heal in the lengthened position. I try to shape the nose with the dressing for the best aesthetic result possible. This does not guarantee that it will look good when it heals, but if the nose does not look good when the patient leaves the operating room, it will not look better later.

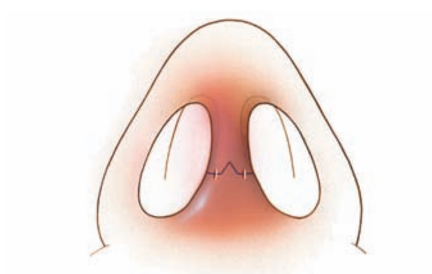
OPERATIVE TECHNIQUE

Anesthesia

Both general endotracheal and intravenous sedation anesthesia for rhinoplasty have pros and cons. For short procedures, when very little bleeding is anticipated, intravenous sedation may be preferable. However, I have had problems with blood pooling in the hypopharynx in patients under intravenous sedation. An unprotected airway in a patient with a decreased cough reflex poses serious problems. For this reason I prefer general endotracheal anesthesia. I always place a nasogastric tube during the operation and suction all blood that enters the stomach in an effort to reduce postoperative nausea and vomiting. Patients receive perioperative antibiotics starting 30 minutes before the incision and postoperative antibiotics if indicated.

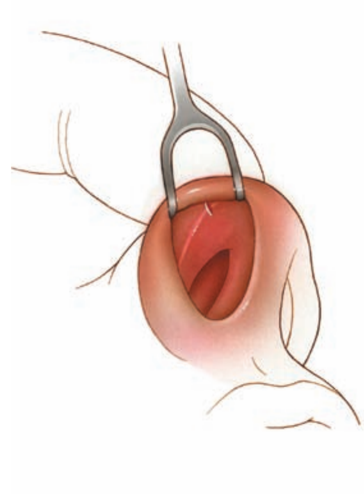
Before a patient is prepared, I swab the interior of the nose with oxymetazoline and inject the external nose and septum with 5 to 6 ml of 1.0% lidocaine with 1:1000 epinephrine. The nose is packed with strips of 1-inch NuGauze approximately 18 inches long and soaked in oxymetazoline. The face and nose are then prepared with half-strength povidone-iodine solution, and the patient is draped in a sterile manner.

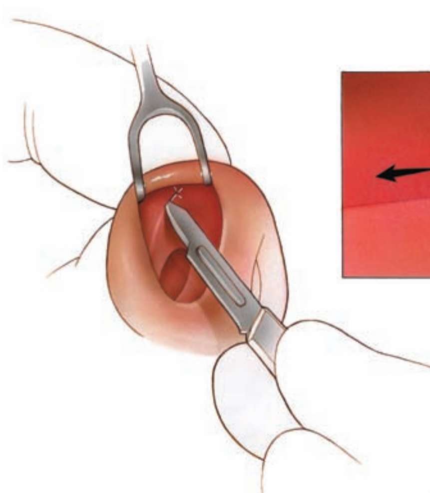
Incisions

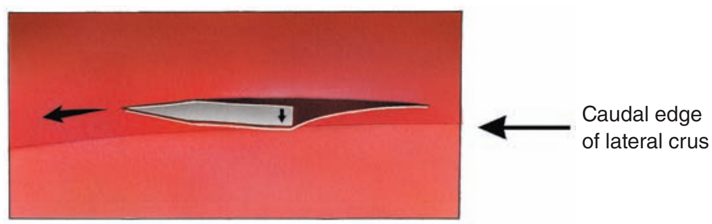


The transcolumellar incision is marked just anterior to the flare of the feet of the medial crura. The design of the incision is not critical as long as it is a broken line and perpendicular to the skin surface. The one I find easiest to close and am presently using is the inverted, notched incision. After the incision is marked, two superficial crosscuts are made on each side of the notch to facilitate precise closure at the end of the operation.

To visualize the marginal incision site, a 12 mm double-pronged skin hook is placed inside the alar rim with the medial hook at the vestibular apex. To identify the caudal margin of the lateral crus, mild tension is placed on the skin hook and the ala is pushed into the vestibule using the fourth finger. This makes the caudal margin prominent. The edge is usually seen under the vestibular skin or identified by feeling the step-off with the back end of the knife handle. Another superficial crosscut is made across the incision site, midway between the hooks, to facilitate accurate closure.



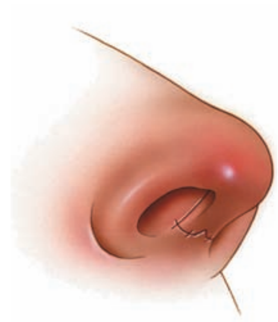




With the skin hook in place, the marginal incision is begun just lateral to the apex and extends laterally along the caudal margin of the lateral crus. To prevent cutting into the cartilage, the back edge of a No. 15 blade is pushed against the caudal edge of the cartilage, with the cutting edge rotated slightly away from the caudal margin. With the back edge of the knife palpable against the cartilage, it is slid along the caudal margin and stopped short of the lateral crus–accessory cartilage junction.

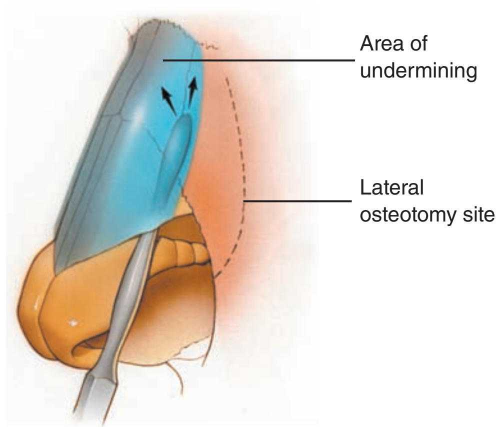
Attention is then directed back to the starting point lateral to the apex, where the incision is continued medially along the caudal margin just inside the roll of the columella to slightly past the level of the transcolumellar incision. The most difficult part of the incision is in the area of the apex. Sometimes it is challenging to gain adequate exposure in this area with the double-pronged skin hook; some surgeons prefer to make the incision along the columella first and then connect the medial and lateral incisions across the vestibule with small scissors.

The transcolumellar incision is made last with a No. 15 blade, which is held perpendicular to the skin surface. Care is required to not cut the caudal margins of the medial crura. It meets the marginal incision laterally and continues superficially past it for 2 to 3 mm. This extension past the junction with the transcolumellar incision forms a crossmark for orientation during closure. The notch is cut using a No. 11 blade.



Undermining

Undermining over the lateral crura, columella, and upper lateral cartilages is performed with small, sharp, pointed scissors, leaving little or no soft tissue on the perichondrium. Undermining extends 2 mm past the osteocartilaginous cartilage junction onto the nasal bones, where the points of the scissors are used to scratch through the periosteum. The periosteum is elevated with a periosteal elevator. Because periosteum does not stretch, it is impossible to elevate as a continuous sheet and will tear. However, the subperiosteal plane is nevertheless desired for elevation.



Over the bony dorsum, undermining extends laterally only as far as needed for exposure. Because it is never raised as far as the lateral osteotomy site, some periosteum will remain attached to the bone for stability anterior to the lateral osteotomy site. Undermining over the lateral crura and upper lateral cartilages extends only as far as needed for exposure.

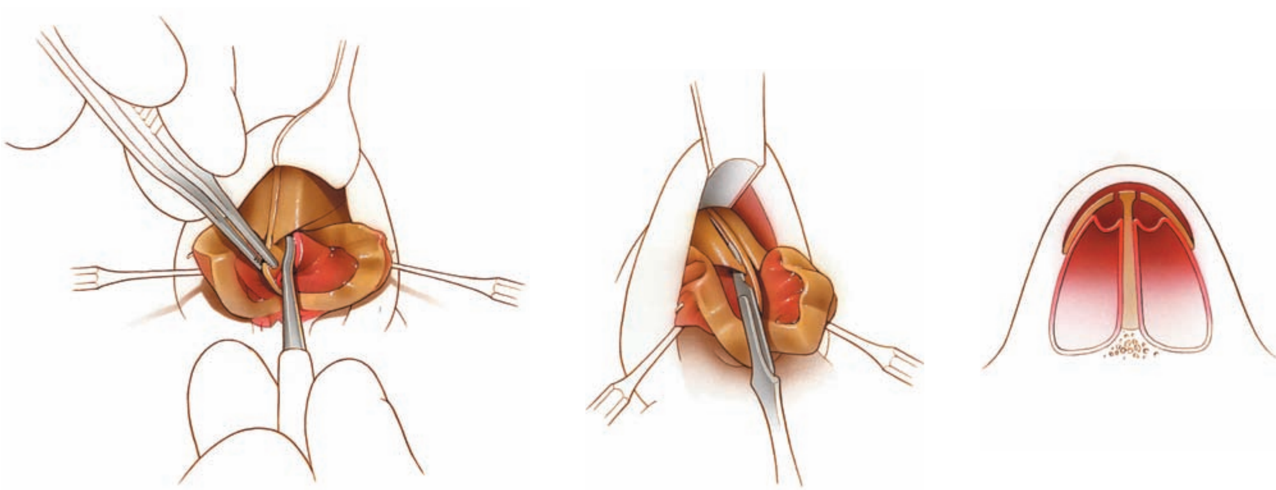
I undermine the soft tissue off the medial surfaces of the medial crura so that I can better visualize the crura and more precisely place sutures through the crura. Undermining continues through the soft tissue of the membranous septum to access the caudal septum. If a columellar strut is to be used, a pocket is

undermined between the feet of the medial crura toward the nasal spine. It stops short of the nasal spine to preserve a soft tissue pad at the base of the pocket, between the strut and the spine, so that the end of the strut will not flip back and forth over the spine during upper lip movements.

With the caudal end of the septum now exposed, work can begin on the septum. However, it is delayed until the dorsum has been reduced as needed: If septal cartilage is resected, the remaining dorsal septum must be at least 8 to 10 mm in width to maintain support. If the septoplasty is performed first, leaving a dorsal width of 8 to 10 mm, the dorsal septum cannot be lowered without some risk.

Dorsal Surgery

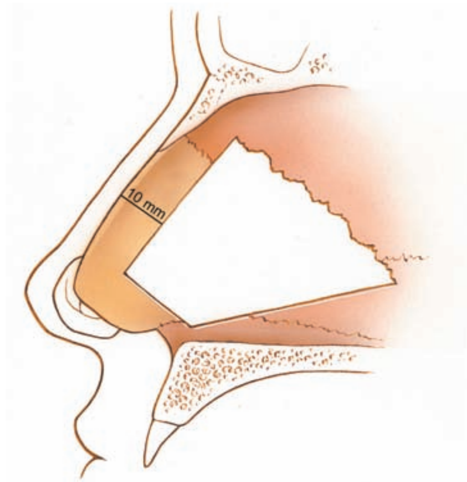
If dorsal reduction is indicated, the surgeon determines whether to reduce the bony or the cartilaginous dorsum first. I usually treat the bony dorsum first using either a rasp or a guarded air-driven drill to reduce and/or smooth the bony dorsum. Before the bony dorsum is lowered to its correct height, the cartilaginous dorsum is reduced somewhat, and the two are compared to ensure that the dorsum is not being overcorrected. The amount of reduction will depend on the final tip projection. Therefore the surgeon must determine the final tip projection before carrying out the final dorsal reduction.



Reduction of the cartilaginous dorsum begins with elevation of the mucosa off both sides of the dorsal septum with a small elevator, maintaining submucosal tunnels 5 to 6 mm in depth. This elevation is carried onto the medial undersurface of the upper lateral cartilages. A No. 15 blade is used to separate the upper lateral cartilages from the dorsal septum by incision through their junctions bilaterally. The dorsal septum is then lowered incrementally and checked periodically to prevent overresection. The upper lateral cartilages are lowered, along

with the dorsal septum, but are kept slightly higher, because they will lose some of their projection when the skin redrapes over these flaccid cartilages. When the bony dorsum and the dorsal septum are nearly the correct height, they are left to be finished after the osteotomies are performed, because the nasal bones can lose projection after osteotomies if they are unstable or move posteriorly when infractured. Although some surgeons perform the osteotomies at this point, I defer this to the end of the procedure. Osteotomies are the most traumatic part of the operation, and if performed early, they can cause swelling that may hinder intraoperative evaluation.

Septal Surgery

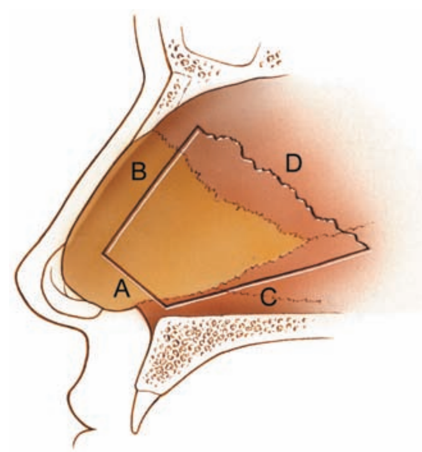


After the dorsum is reduced, all necessary septal surgery is performed to procure cartilage grafts or straighten a deviated septum, making certain that the cartilaginous support of the nose is not lost. This is achieved by maintaining an intact L-shaped strut of dorsal and caudal septum for support of the lower two thirds of the nose. The width of the L-shaped strut will vary, but 10 mm is a good rule of thumb, and 8 mm is the minimum.

Nasal packing is removed and elevation of the mucoperichondrium started at the caudal septum on the side to which the septum is deviated. If only the septum is to be harvested for grafting, dissection is started on the side that is easiest for the surgeon. Small, sharp, pointed scissors are used to scratch through the perichondrium until a bluish hue appears through the cartilage, signaling penetration of the perichondrium. The mucosa with its intact perichondrium is then elevated off and around the area to be resected. If the deviation is extensive or a large piece of cartilage is needed for reconstruction, the mucoperichondrium is elevated off the entire septum, maxillary crest, and anterior two thirds of the vomer and perpendicular plate.

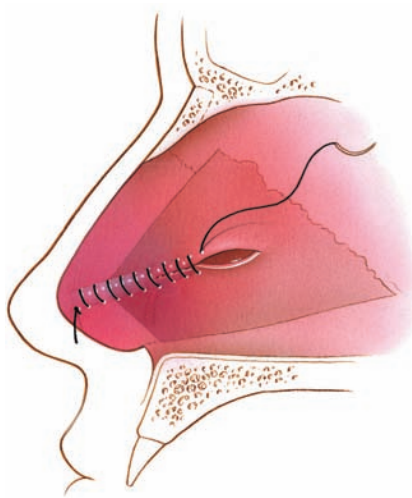
The most difficult part of the elevation is in the area of the maxillary crest anteriorly, where the mucoperiosteum of the crest fuses with the mucoperichondrium of the septum. The lining in this area is tightly adhered to the osteocartilaginous junction. It is easiest to elevate this area by starting at the septal–maxillary crest junction posteriorly, where the mucoperichondrium and mucoperiosteum are less adherent, and continue the elevation as far anteriorly as possible.

With the mucoperichondrium now elevated to the septal–maxillary crest osteocartilaginous junction anteriorly, an incision *(A)* is made through cartilage only parallel to the caudal end of the septum, starting inferiorly at the junction of the cartilage with the maxillary crest 10 mm posterior to the caudal margin. It is extended to within 10 mm of the dorsum. An incision *(B)* is made from the anterior end of the caudal incision, parallel to the dorsal septum, to the junction of the perpendicular plate of the ethmoid, preserving 10 mm of dorsal width. Through these incisions the mucoperichondrium is elevated off the opposite side in the area to be resected. The dorsal incision is extended through the perpendicular plate of the ethmoid with a Mayo or double-action scissors. The septal border that abuts the maxillary crest posterior to the incision is then elevated off the maxillary crest *(C)*. If the maxillary crest is deviated and resection is indicated, an angled elevator is used to elevate over the ridge down to the floor of the nose to expose the area for resection.



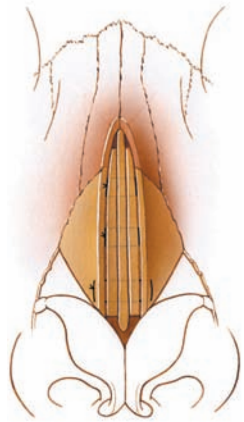
With the incisions made on the caudal and dorsal septum and the inferior septum elevated off the maxillary crest, the area to be resected is freed on three sides. The fourth side *(D)* is freed by using an angular elevator to break through the thin perpendicular plate of the ethmoid from the posterosuperior end of the dorsal incision to the posterior end of the freed inferior septal-vomer border.

This completely frees the area to be excised, which is composed of both cartilage and the perpendicular plate of the ethmoid. The perpendicular plate of the ethmoid is included to ensure that as much cartilage as possible has been resected. Pieces of the thin, pliable perpendicular plate can be employed as small onlay grafts, and thicker pieces can be burred smooth and drill holes placed to be used as struts to help straighten any curvature of a deviated cartilaginous dorsum or a C-shaped caudal segment.



If the mucosa is accidentally perforated during elevation or resection, it presents no problem if no opposing perforation is present. If opposing perforations exist in any area of the anterior half of the mucoperichondrium, at least one side needs to be closed. This can be performed readily by passing a suture (4-0 or 5-0 chromic suture on a small curved needle) through the mucoperichondrium anteriorly, where it is easy to tie, preserving a tag on the free end. A simple running stitch is extended posteriorly to the perforation, which is then closed. It is continued past the posterior end and then runs anteriorly, where it is tied to the tag of suture left at the original knot anteriorly.

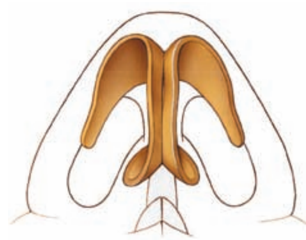
It is usually impossible to remove this large piece of cartilage from the nose through a transfixion incision, and separation of the upper lateral cartilages from the septum is typically required. All straight pieces of cartilage or perpendicular plate of the ethmoid that are left after the grafts are cut, or any portions of deviated cartilage that can be cut so they are straight, are returned to the area of resection and stabilized with sutures to prevent overlap. These can be used if revision surgery is necessary.



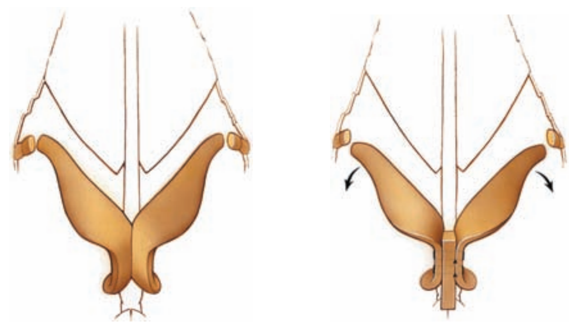
Dorsal spreader grafts are used in almost all cases of significant hump removal, especially in patients with short nasal bones, to prevent upper lateral cartilage collapse. They are placed after the septal surgery is completed. In addition to prevention of upper lateral cartilage collapse, they can be useful to widen the dorsum or straighten a curved dorsal septum. These grafts are placed at the same level as the dorsal septum and can extend to the osteocartilaginous junction to prevent upper lateral cartilage collapse, or further superiorly to help control the width of the bony dorsum after osteotomy. If the dorsal septal strut is curved, it can be straightened by perpendicular partial-thickness cuts the entire width of the strut on the concave side. This will make this area of the septum more flaccid so that it can be straightened and suture stabilized with spreader grafts to sandwich the septum between them. Spreader grafts can be extended caudally past the septal angle to aid in lengthening the nose or increasing tip projection (see Chapter 23).

Nasal Tip Surgery

A piece of the septal cartilage is used for a columellar strut graft in almost all patients having open rhinoplasty. The strut is placed to increase or maintain tip projection, but mainly it helps to stabilize the medial crura to serve as a foundation for shaping the tip. It assists in maintaining the width of the columella, which can be lost if the medial crura are sutured directly together. The strut is placed in the previously made pocket between the medial crura.

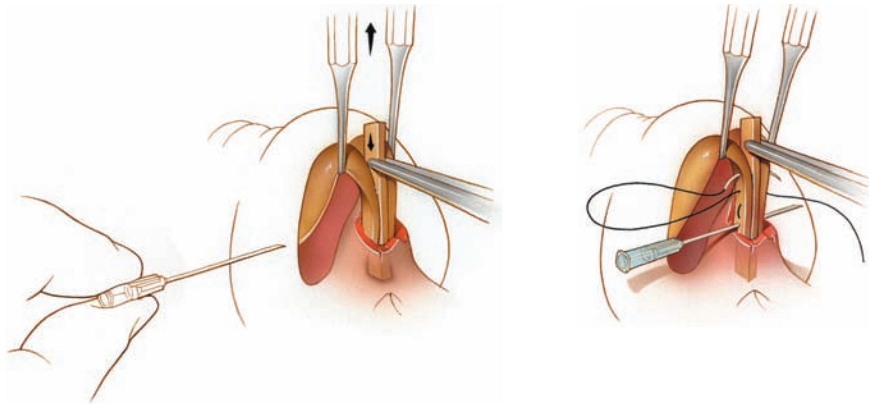


In a normal relationship of the medial crura, the cephalic edges abut and the caudal edges that give the columella its width are separated. Knowledge of this anatomy is crucial when suturing the columellar strut graft to the medial crura.

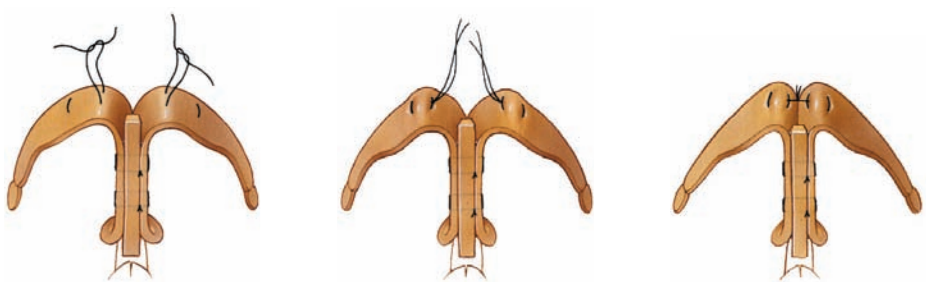


If the medial crura are sutured directly to the columellar strut, they become parallel to each other. The columellar strut graft will help to maintain columellar width, but a downward torque will be placed on the lateral crura. This is especially true the closer the sutures are to the level of the medial walls of the domes. Sometimes torque is desirable, but if the cartilages are flaccid, very little torque may be produced.

To prevent torque, one or two sutures are placed just inside the cephalic margins of the medial wall of the domes at an equal distance from the tip-defining points. They are tied before the columellar strut graft is placed. This will maintain abutment of the cephalic margins and counteract the tendency for them to flare when the strut is sutured in place.

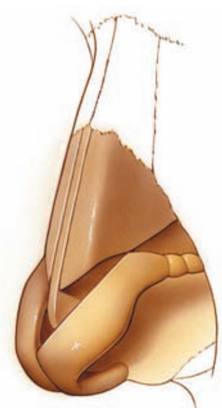


To increase tip projection with a columellar strut graft, a double-pronged skin hook should be placed in the underneath surface of the domes at the apices of the nostrils and pulled away from the nasal spine. The columellar strut graft is placed in the undermined pocket between the medial crura and forced toward the spine. A 25-gauge needle is then passed through the medial crura and the columellar strut graft, which is sandwiched between them to maintain the tension while the columellar strut graft is sutured in place. This will increase tip projection very little but will stabilize the cartilages so the lateral crura can be advanced medially with horizontal mattress sutures to increase projection of the domes. This method provides 2 mm of tip projection at most.



Techniques that provide more tip projection are advancement of the medial crura on extended spreader grafts and the use of tip grafts. I find that tip projection is most reliably increased with an autologous rib cartilage graft and an internal K-wire extended 10 mm from the base and placed in a drill hole in the maxilla. However, this method is applied almost exclusively in secondary rhinoplasty.

A columellar strut graft can be helpful to control the degree of the columellar-lobular angle. The angle can be increased or decreased by the way it is sutured to the strut. If the medial crura are strong and stiff, it may be necessary to undermine the vestibular skin at the area of the angle and partially incise the crura at the angle before they are sutured to the strut. However, if they are weak and flaccid, partial incision may not be necessary.

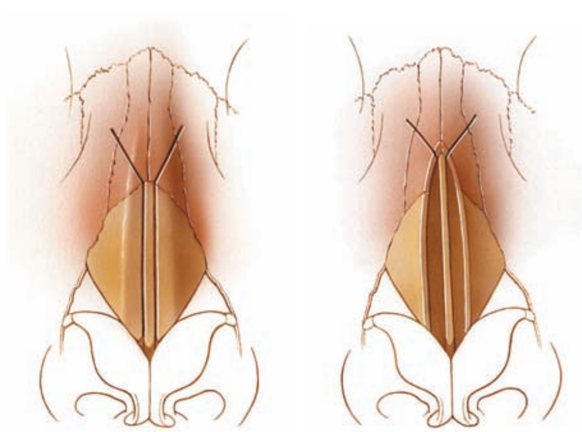


Attention is now directed to the lateral crura. The shape and size will determine whether cartilage needs to be resected. In most cases, the scroll area of the cephalic margin will need to be resected, especially if reduced tip fullness is desired. This requires preservation of as much cartilage as possible without compromising the aesthetic result. In general, the desired shape requires lateral crura with minimal bowing, oriented to have no alar retraction. The domes should be angular enough to form subtle tip-defining points with the desired distance between them. The degree of the angle and the distance will depend on the thickness of the skin.

Angulation of the domes and the distance between the tip-defining points can be controlled with transdomal horizontal mattress sutures. If the lateral crura are distorted or malpositioned, they need to be corrected by methods described in Chapters 29 and 30.

Osteotomies

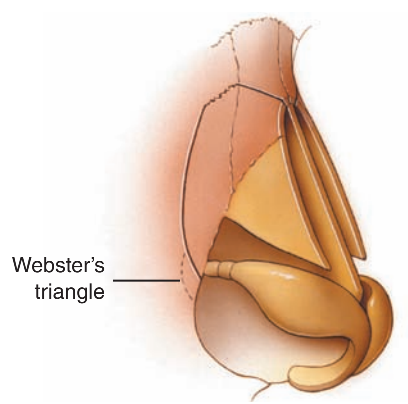
Before the tip is stabilized completely, indicated osteotomies are performed to allow final trimming of the dorsum. Medial osteotomies are needed only if the bony dorsum is excessively wide, the nasal bones are deviated, or the bony dorsum is excessively narrow and needs to be widened with spreader grafts.



Medial osteotomies are performed with a 7 mm osteotome starting at the inferior junction of the nasal bones with the dorsal septum and angled toward the medial canthus, without involving the thick bone at the root of the nose. The angle of the osteotomies depends on whether or not a hump has been removed and how much was removed. Osteotomies begin closer to the root as more hump is removed and will require a greater angle to avoid the root. If no hump has been removed, the junction of the inferior edge of the nasal bone with the septum will be farther away from the root and will require less of an angle. The leading edge of the osteotome must be very sharp to initiate the osteotome in the correct direction. If a hump has been removed and an open roof is present, the inside edge of the nasal bone will curve inward as it is followed superiorly. A dull osteotome

has a tendency to follow the inward curve and will end in the thick bone of the root. The farther it travels into the root, the thicker the bone is and the more difficult it is to outfracture. Medial osteotomies should end no higher than the level of the medial canthus.

I prefer to perform lateral osteotomies internally. Although I do not object to percutaneous osteotomies, they do not give me the control offered by internal osteotomies. Osteotomies are performed by making an opening with Iris scissors through the vestibular skin anterior to the end of the inferior turbinate. The scissors are inserted down to the periosteum lateral to the piriform aperture rim and spread just enough to accommodate a curved osteotome with a small guard on the lateral edge. The edge of the piriform aperture is palpated with the blade of the osteotome. By pressing the guard against the lateral surface and palpating it with the index finger of the free hand, the blade is walked to the desired starting position on the rim. This is usually at the level of the attachment of the anterior end of the inferior turbinate. It is slightly more anterosuperior than the most posterior point of the piriform aperture edge.

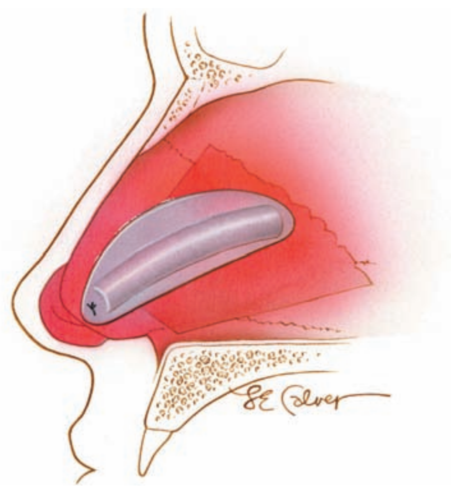


Theoretically, if the osteotomy is started low (at the most posterior point of the piriform aperture), infracture can move the anterior end of the inferior turbinate medially and compromise the airway in that area. Initiation of the osteotomy more superiorly on the rim prevents this problem, but requires that the osteotome is angled toward the maxilla at the start so that it can proceed to the nasal-cheek junction, where it continues superiorly. As the osteotome is moved superiorly, it is curved toward the nasal root. It is stopped at the level of the medial canthus, where it should be a few millimeters from the lateral end of the medial osteotomy. Gentle digital pressure is applied to create a greenstick infracture. Under ordinary circumstances, a greenstick fracture is preferred, because a complete fracture is unstable and more difficult to control.

If a medial osteotomy was not performed, the infracture is accomplished by rotating the guard of the osteotome toward the dorsum while gently moving the

free end of the osteotome medially. This will result in a greenstick fracture from the superior end of the osteotomy site through the weakest line of the nasal bone. With the osteotomies completed and the tip projection set, the bony dorsum, upper lateral cartilages, and septum are refined as indicated to the correct height. The ends of the upper lateral cartilages are sutured in place to the septum for stabilization. The final tip shape is completed, the skin redraped, and the result assessed.

Splints, Closure, and Dressings



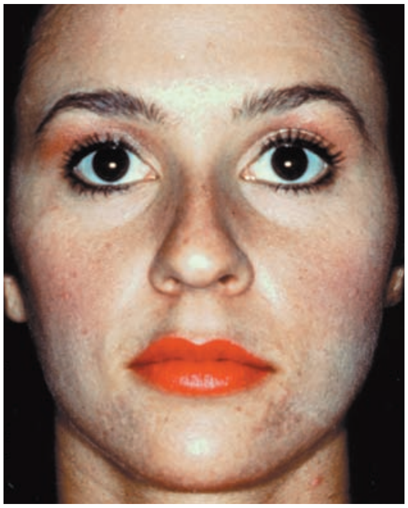
Before closure, a soft plastic splint with an airway on the sides is placed in each nostril. Although the airways may get clogged with blood and mucus, the advantage of this type of splint is that the inferior turbinates press against the splint airways to sandwich the septum between the flat sides of the splints, thereby immobilizing the septum in the midline. A 3-0 through-and-through monofilament suture is placed through the anterior end of the splints and caudal septum to hold them in place. However, this is usually delayed until after closure of the incisions to allow a last evaluation before the anterior ends of the splints are brought forward into the vestibule, which causes increased fullness of the alae.

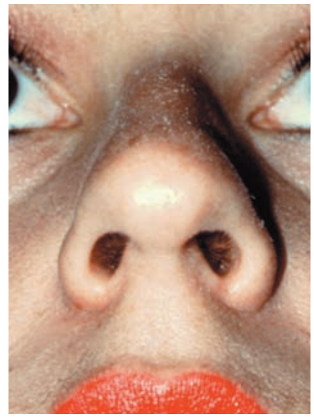
The crosscuts are aligned and the wound is sutured with a single layer of 6-0 monofilament nylon suture to close the transcolumellar incision. Magnifying loops can be used for more accurate closure. The marginal incision is closed with 4-0 or 5-0 chromic catgut after crosscuts are aligned. Occasionally a marginal suture causes slight notching or distortion of the alar rim. It should always be removed and replaced to prevent a permanent irregularity of the rim. Alar base resections, if indicated, are performed after closure is complete and before the splints are sutured in place.

The nose and face are cleansed with a wet sponge. Alcohol and a layer of Mastisol are applied to the nasal skin and adjacent cheek skin. Steri-Strips are then taped to the nose to help mold the nose to the best aesthetic shape possible. A padded, sticky aluminum cast is symmetrically bent over a tapered ½-inch or ¾-inch rod, placed over the nasal bones, and gently squeezed to mold the nasal bones into position. The caudal end of the cast should not reach the supratip area. If it does, squeezing of the cast causes the caudal end to rise, pulling the supratip skin off the framework and creating a dead space in the supratip area. This will fill with blood or serum and can cause an undesirable fullness in that area. Pledgets of Gelfoam impregnated with an antibiotic ointment are placed in each nasal vestibule to pack any redundant vestibular skin back into place. A 1-inch strip of paper tape 2½ inches long is placed on each cheek so that the tape of the mustache dressing can be stuck to the cheek tapes instead of to the skin. This prevents the skin from becoming irritated and macerated when the mustache dressings are changed.

The nasogastric tube is suctioned, and the patient is awakened and taken to the recovery room. The patient is allowed to go home later that day. The patient returns to the office 6 or 7 days later, at which time the splints, cast, and sutures are removed in that order. The patient is routinely seen at 2-week, 4-month, 1-year, and 2-year intervals thereafter.

CASE ANALYSES

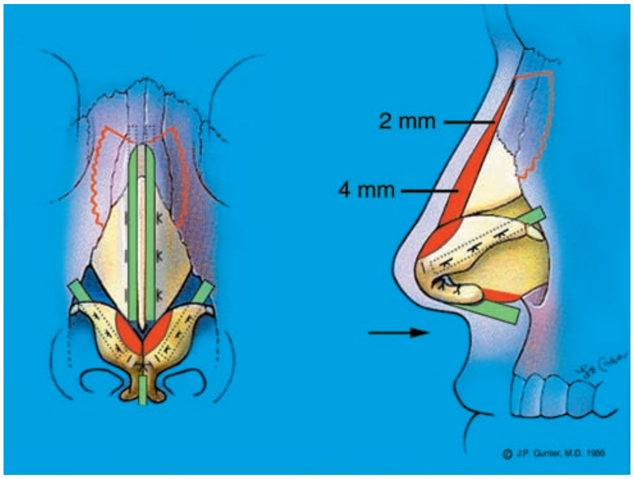


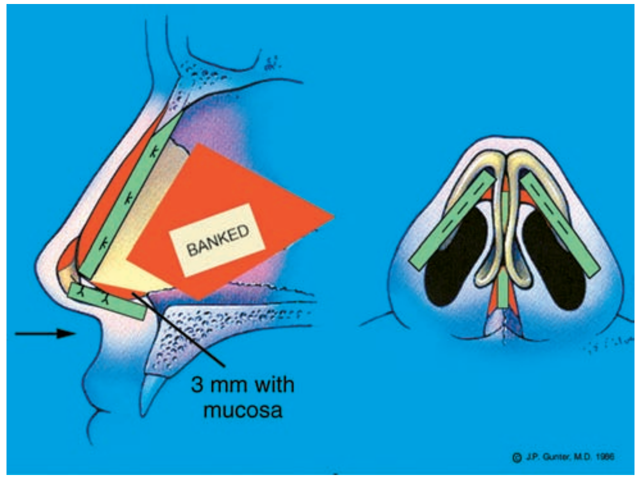


This 22-year-old woman complained of difficulty in breathing through the left side of her nose and requested cosmetic improvement of her nasal appearance. Her main concerns were her large nose with a small nasal hump and fullness of the tip. On the frontal view, a very narrow nasal dorsum and borderline bony base width were noted. The tip was wide and lacked definition. The alar base width was within normal limits. The profile view showed that the nasofrontal angle was in good position, but the tip had increased projection off the facial plane, resulting in a fullness of the columellar-labial angle and slight tension of the upper lip. The basal view showed increased fullness of the nasal tip. Internally the septum was deviated to the left, partially blocking the airway on that side.

The operative goals included the following:

- Widen the nasal dorsum.
- Narrow and sculpt the nasal tip.
- Remove the nasal hump to develop a straight nasal bridge with a slight supratip break.
- Set the nose closer to the facial plane to relieve some of the fullness in the columellar-labial angle and tension on the upper lip.





With the patient under general endotracheal anesthesia, the nose was injected with 1% lidocaine with 1:100,000 epinephrine and hyaluronidase. The internal nose was packed with gauze soaked with oxymetazoline. Bilateral marginal incisions were connected to a stair-step transcolumellar incision, and the soft tissue was elevated off the osteocartilaginous framework. The nasal bones were lowered approximately 2 mm with a rasp. Bilateral submucosal tunnels were developed at the dorsal septum–upper lateral cartilage junction. The upper lateral cartilages were separated from the dorsal septum with a No. 15 blade. The cartilaginous septum was lowered approximately 4 mm with angled scissors, and the upper lateral cartilages were trimmed minimally. Medial osteotomies and outfracturing were performed to aid in widening the nasal dorsum.

An extended complete transfixion incision was made to free the attachments of the columella to the caudal septum. The caudal margin of the septum with its mucoperichondrium was removed to reduce the fullness at the columellar-labial angle. The mucoperichondrium was elevated off the left side of the nasal septum. The septal deformity was corrected by partial resection. The resected cartilage was carved into dorsal spreader grafts that were placed bilaterally and sutured with 5-0 Vicryl to widen the dorsum. A columellar strut graft was placed in a pocket undermined between the medial crura and sutured with 5-0 Vicryl for stabilization.

The cephalic margins of the lateral crura were trimmed, and the vestibular skin was elevated off the underneath surface of the lateral crura to the attachment at the caudal margins. Strips of septal cartilage (3 by 25 mm) were placed on the underneath surface of the lateral crura and sutured with 5-0 Vicryl to straighten the crura. Transdomal horizontal mattress sutures were placed to narrow the domes and move them closer together. The remaining septal cartilage was returned to

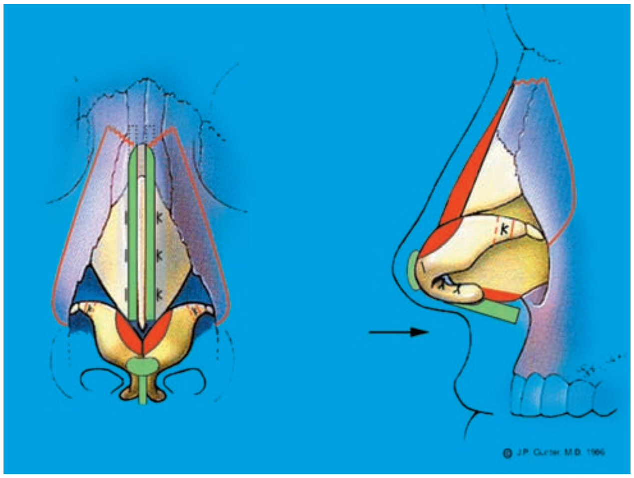
the septal pocket. The incisions were closed with 4-0 chromic catgut sutures and interrupted 6-0 black nylon to the transcolumellar incision. Septal splints that had been placed before closure were sutured with through-and-through 3-0 black nylon. An external dressing using Steri-Strips and an aluminum cast were placed.

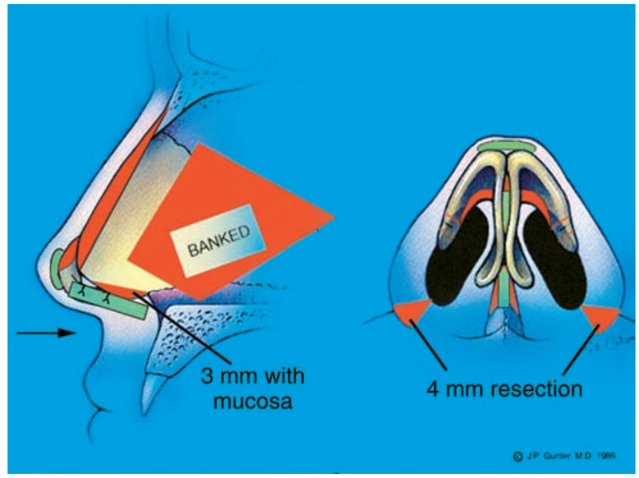
One year postoperatively, the patient has a widened, more sculpted dorsum and decreased width of the nasal tip on the frontal view. On the profile view, her nose is closer to the facial plane, and the fullness of the columellar-labial angle is improved. On the basal view, her tip is more symmetrical, although the distance between the tip-defining points could be narrower.

This 38-year-old woman had nasal airway obstruction, greater on the right than on the left. She was on a regimen of prednisone and steroid nasal sprays, as prescribed by her allergist. In addition to improved breathing, she requested cosmetic improvement of her nose. On the frontal view, her tip and dorsum leaned to the left. The bony base and supratip area were wide. Alar base width was borderline. On the lateral view, the nasofrontal angle was in good position with a straight dorsum and a slight supratip break, but the nasal tip had increased projection. Very little nostril show was evident, with increased fullness of the columellar-labial angle. The chin appeared weak in the anterior and vertical direction. The basal view revealed a wide nasal tip that leaned to the left, with some asymmetry of the nostrils. The internal examination demonstrated mild hypertrophy of the turbinates with deviation of the septum that was causing significant airway obstruction.

The operative goals included the following:

- Straighten the dorsum and tip.
- Narrow the bony base.
- Decrease tip projection.
- Reshape the tip.
- Improve the nasal airway (major goal).
- Perform a mentoplasty to advance the chin and increase vertical height.





A general endotracheal anesthetic was given, and the patient's face was prepared and draped in a sterile manner. A mentoplasty was performed before the rhinoplasty. An extended-arm Silastic implant that overlapped the inferior mandibular border was used. The nose was injected with 1% lidocaine with 1:100,000 epinephrine and hyaluronidase. The internal nose was packed with gauze soaked with oxymetazoline. An extended complete transfixion incision was made to release supporting elements of the caudal septum to the tip to aid in decreasing tip projection. Bilateral marginal incisions were connected to a stair-step transcolumellar incision. The soft tissue was elevated off the osteocartilaginous framework.

The dorsum was rasped, submucosal tunnels were made, and the upper lateral cartilages were separated from the septum. The septum and upper lateral cartilages were lowered with angled scissors. The mucoperichondrium was elevated off the left side of the nasal septum, and the nasal septum deformity was corrected by partial resection and a swinging-door–type flap. Part of the resected septal cartilage was used for spreader grafts, which were placed along the sides of the dorsal septum and sutured with 5-0 Vicryl to help straighten the dorsal septum. Lateral osteotomies were performed to shift the nasal bones to the midline. The upper lateral cartilages were sutured to the spreader grafts and septum at the septal angle for stabilization.

The cephalic margins of the lateral crura were trimmed. Laterally, the vestibular skin was undermined off the underneath surface of the lateral crura near their junction with the accessory cartilages. The cartilages were transected in this area, overlapped 3 mm, and sutured with through-and-through 5-0 Vicryl to reduce projection of the lateral crura. Part of the caudal septum and mucosa was removed to decrease fullness in the nasolabial angle. A columellar strut graft was placed between the medial crura and sutured with 5-0 Vicryl to help stabilize the tip. Transdomal horizontal mattress sutures of 5-0 clear nylon were placed in the dome areas bilaterally to increase the angulation of the domes and move

them closer together. A resected cephalic margin from one of the lateral crura was used as an onlay graft over the domes to soften the angulation of the domes.

The internal incisions were closed with 4-0 chromic catgut sutures and the transcolumellar incision with interrupted 6-0 black nylon. It was then evident that decreased tip projection had caused flaring of the nasal alae. Bilateral alar base resections were performed. Approximately 4 mm of skin was resected at the widest portion. These wounds were closed with 6-0 nylon sutures. Septal splints that had been placed before closure were sutured with through-and-through 3-0 black nylon. An external dressing using Steri-Strips and an aluminum cast were placed.

One year postoperatively, the frontal view shows the dorsum and tip in the midline. The fullness and asymmetry of the tip and supratip areas are corrected, width of the alar bases is good. On the profile view, the dorsum is slightly concave with decreased tip projection and a small supratip break. The basal view shows a triangular tip with improved nostril symmetry. The nasal-jaw relationship is improved by the mentoplasty.

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Rohrich's Approach

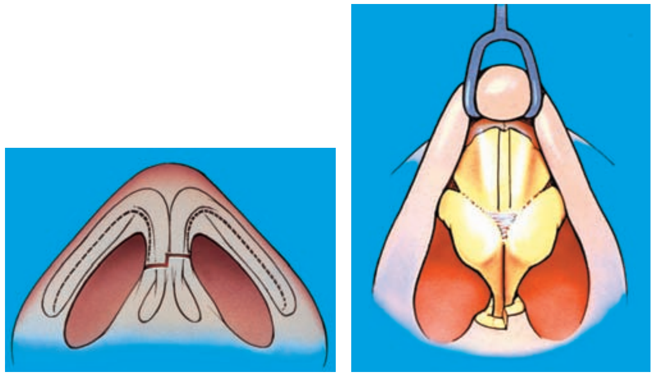
Rod J. Rohrich ▪ Jamil Ahmad

Rhinoplasty is one of the most difficult and challenging operations in cosmetic surgery. The difference between a good result and a poor one is often measured in millimeters, leaving little room for error. The initial procedure is critical, because tissues are native and undistorted by surgical intervention. That is why systematic nasal analysis and careful preoperative planning are so crucial to a well-executed procedure. Excellence in rhinoplasty is an ongoing learning process based on critical analysis of long-term results and continuing feedback from colleagues. Over the past 25 years, we have evolved and adapted a variety of concepts and techniques to improve consistency and reproducibility of results after rhinoplasty.[1-46]

The basic principles for successful primary rhinoplasty include the following:

1. Thorough clinical analysis and definition of goals preoperatively
2. Careful preoperative preparation of the patient
3. Precise operative execution
4. Adequate postoperative management
5. Expertise and experience are gleaned from critical analysis of one's own results

The open rhinoplasty approach affords tremendous control, allowing incremental and precise alteration of the nasal structures to consistently produce reliable, durable, and natural results that meet functional and aesthetic goals. We are proponents of the open approach because it provides unparalleled exposure for accurate anatomic diagnosis and systematic technical execution.



The full and undistorted exposure of the underlying nasal framework afforded by the open approach has allowed us to obtain excellent aesthetic and functional results in patients with primary nasal deformities. It permits a binocular view of the framework so that it can be reliably and consistently modified. The major objection to the open rhinoplasty approach is the transcolumellar scar, but if the surgery is performed well, it results in nearly imperceptible scars that have not been of any issue to our patients. In our experience, other potential disadvantages of the open approach that are commonly cited, such as wound separation, prolonged operative time, prolonged tip edema, and delayed secondary healing, have not been problematic.

THE CONSULTATION

Success in rhinoplasty depends on more than excellent technique; good communication is crucial for understanding patient expectations and defining realistic goals. The emotional stability of the patient greatly influences the doctor-patient relationship. The initial interview serves to determine whether a patient is a candidate for rhinoplasty, both physically and psychologically. During consultation we encourage our patients to explain their concerns and define their expectations so that we can assess whether these can be achieved realistically. Patients are asked to list specific complaints concerning nasal appearance and function and to rank problems in order of importance. It is helpful to ask the patient, "If you had only one problem that could be corrected, what would it be?" This "one thing" is then recorded verbatim in the patient's notes. It is important to learn to differentiate between healthy and unhealthy motivations for seeking rhinoplasty. Poor results are often a reflection of emotional dissatisfaction rather than technical failure. Therefore, when faced with a patient who focuses on a minor or imperceptible problem or one who is unhappy or angry with a previous surgeon, it is often wise not to proceed with surgery.

Specific nasal problems such as asymmetry, tip deformity, supratip deformity, dorsal irregularity, nasal airway obstruction and septal perforation are pointed out to the patient and discussed. The patient needs to understand the proposed

surgical plan and the potential sequelae. Complications are fully outlined and disclosed before obtaining an informed consent for rhinoplasty and any other indicated procedures, such as rib or auricular graft harvesting (see Chapter 5).

Photographs can demonstrate problems that will persist postoperatively or are inevitable consequences of the procedure, such as notches, grooves, and irregularities. Facial disproportions are pointed out to the patient with an explanation that facial asymmetry will not be corrected by the surgery. We personally explain to all patients what is involved in postoperative care and provide specific preoperative and postoperative instruction sheets at the time of the initial consultation (see Chapter 8). We phone our rhinoplasty patients the evening after their surgery and see them 5 to 7 days later in the office. Patients are then examined 3 and 6 weeks and 3, 6, and 12 months after surgery and annually thereafter.

To My Patients:

Our goal is to provide the optimal result with your nasal surgery. However, infrequently, operative revisions may be required 6 to 12 months after nasal surgery. As you know, plastic surgery is both art and science. If you have problems with wound healing or other factors that do not allow optimal healing, a surgical revision may be necessary. In this instance the surgeon's fee will be negotiable; however, you will be accountable for the fees related to the operating room, anesthesia, or hospitalization.

I like to address these issues before surgery so that we may discuss this during the preoperative evaluation and consultation. We value your loyalty and will do everything to maximize your care and result from your nasal surgery.

If you have any further questions, please do not hesitate to discuss these with me or any of my staff.

Warmest personal regards,

Physician signature: ____

I have read the above and understand and agree to this policy regarding nasal revisional surgery.

Patient signature: ____

Date: ______________________________

INFORMED CONSENT INFORMATION SHEET

This is an informed consent document that has been prepared to help your plastic surgeon inform you concerning rhinoplasty surgery, its risks, and alternative treatment. It is important that you read this information carefully and completely. Please initial each page, indicating that you have read the page, and sign the consent for surgery as proposed by your plastic surgeon.

INTRODUCTION

Surgery of the nose (rhinoplasty) is an operation frequently performed by plastic surgeons. This surgical procedure can produce changes in the appearance, structure, and function of the nose. Rhinoplasty can reduce or increase the size of the nose, change the shape of the tip, narrow the width of the nostrils, or change the angle between the nose and the upper lip. This operation can help correct birth defects, nasal injuries, and some breathing problems.

There is not a universal type of rhinoplasty surgery that will meet the needs of every patient. Rhinoplasty surgery is customized for each patient, depending on his or her needs. Incisions may be made within the nose or concealed in inconspicuous locations of the nose in the open rhinoplasty procedure. Internal nasal surgery to improve nasal breathing can be performed at the time of the rhinoplasty.

The best candidates for this type of surgery are individuals who are looking for improvement, not perfection, in the appearance of their nose. In addition to realistic expectations, good health and psychological stability are important qualities for a patient considering rhinoplasty surgery. Rhinoplasty can be performed in conjunction with other surgeries.

ALTERNATIVE TREATMENT

Alternative forms of management consist of not undergoing the rhinoplasty surgery. Certain internal nasal airway disorders may not require surgery on the exterior of the nose. Risks and potential complications are associated with alternative forms of treatment that involve surgery such as septoplasty to correct nasal airway disorders.

RISKS OF RHINOPLASTY SURGERY

With any type of intervention there is inherent risk. An individual's choice to undergo a surgical procedure is based on the comparison of the risk to potential benefit. Although the majority of patients do not experience these complications, you should discuss each of them with your plastic surgeon to make sure you understand the risks, potential complications, and consequences of rhinoplasty.

Bleeding It is possible, although unusual, that you may have problems with bleeding during or after surgery. Should postoperative bleeding occur, it may require emergency treatment to stop the bleeding or a blood transfusion. Do not take any aspirin or antiinflammatory medications for 10 days before surgery as this contributes to a greater risk of bleeding. Hypertension (high blood pressure) that is not under good medical control may cause bleeding during or after surgery. Accumulations of blood under the skin may delay healing and cause scarring.

Infection Infection is quite unusual after surgery. Should an infection occur, additional treatment, including antibiotics, might be necessary.

Scarring Although good wound healing after a surgical procedure is expected, abnormal scars may occur both within the skin and the deeper tissues. Scars may be unattractive and of a different color than the surrounding skin. There is the possibility of visible marks from sutures. Additional treatments, including surgery, may be needed to treat scarring.

Damage to Deeper Structures Deeper structures such as nerves, tear ducts, blood vessels, and muscles may be damaged during the course of surgery. The potential for this to occur varies with the type of rhinoplasty procedure performed. Injury to deeper structures may be temporary or permanent.

Unsatisfactory Result There is the possibility of an unsatisfactory result from the rhinoplasty surgery. The surgery may result in unacceptable visible or tactile deformities, loss of function, or structural malposition. You may be disappointed that the results of rhinoplasty surgery do not meet your expectations. Additional surgery may be necessary should the result of rhinoplasty be unsatisfactory.

Numbness There is the potential for permanent numbness within the nasal skin after rhinoplasty. Its occurrence is not predictable. Diminished (or loss of) skin sensation in the nasal area may not totally resolve after rhinoplasty.

Asymmetry The human face is normally asymmetrical. There can be a variation from one side to the other in the results obtained from a rhinoplasty procedure.

Chronic Pain Chronic pain may occur very infrequently after rhinoplasty.

Skin Disorders/Skin Cancer Rhinoplasty is a surgical procedure to reshape both internal and external structures of the nose. Skin disorders and skin cancer may occur independent of a rhinoplasty.

Allergic Reactions In rare cases local allergies to tape, suture material, or topical preparations have been reported. Systemic reactions that are more serious may occur to drugs used during surgery and prescription medicines. Allergic reactions may require additional treatment.

Delayed Healing Wound disruption or delayed wound healing is possible. Some areas of the face may not heal normally and may take a long time to heal. Areas of skin may die. This may require frequent dressing changes or further surgery to remove the nonhealed tissue. Smokers have a greater risk of skin loss and wound healing complications.

Long-Term Effects Subsequent alterations in nasal appearance may occur as the result of aging, sun exposure, or other circumstances not related to rhinoplasty surgery. Future surgery or other treatments may be necessary to maintain the results of a rhinoplasty operation.

Nasal Septal Perforation There is the possibility that surgery will cause a hole in the nasal septum to develop. This occurrence is rare. However, if it occurs, additional surgical treatment may be necessary to repair the hole in the nasal septum. In some cases it may be impossible to correct this complication.

Nasal Airway Alterations Changes may occur after a rhinoplasty or septoplasty operation that may interfere with normal passage of air through the nose.

Surgical Anesthesia Both local and general anesthesia involves risk. There is the possibility of complications, injury, and even death from all forms of surgical anesthesia or sedation.

HEALTH INSURANCE

Most health insurance companies exclude coverage for cosmetic surgical operations or any complications that might occur from cosmetic surgery. If the procedure corrects a breathing problem or marked deformity after a nasal fracture, a portion may be covered. Please carefully review your health insurance subscriber information pamphlet.

Continued

INFORMED CONSENT INFORMATION SHEET—cont'd

ADDITIONAL SURGERY NECESSARY

There are many variable conditions in addition to risk and potential surgical complications that may influence the long-term result from rhinoplasty surgery. Even though risks and complications occur infrequently, the risks cited are particularly associated with rhinoplasty surgery. Other complications and risks can occur but are even more uncommon. Should complications occur, additional surgery or other treatments might be necessary. The practice of medicine and surgery is not an exact science. Although good results are expected, there is no guarantee or warranty expressed or implied as to the results that may be obtained. Infrequently it is necessary to perform additional surgery to improve your results.

FINANCIAL RESPONSIBILITIES

The cost of surgery involves several charges for the services provided. The total includes fees charged by your doctor, the cost of surgical supplies, anesthesia, and laboratory tests, and possible outpatient hospital charges, depending on where the surgery is performed. Depending on whether the cost of surgery is covered by an insurance plan, you will be responsible for necessary copayments, deductibles, and charges not covered. Additional costs may occur should complications develop from the surgery. Secondary surgery or hospital day surgery charges involved with revisionary surgery would also be your responsibility.

DISCLAIMER

Informed consent documents are used to communicate information about the proposed surgical treatment of a disease or condition along with disclosure of risks and alternative forms of treatment(s). The informed consent process attempts to define principles of risk disclosure that should generally meet the needs of most patients in most circumstances.

However, informed consent documents should not be considered all inclusive in defining other methods of care and risks encountered. Your plastic surgeon may provide you with additional or different information that is based on all the facts in your particular case and the state of medical knowledge.

Informed consent documents are not intended to define or serve as the standard of medical care. Standards of medical care are determined on the basis of all of the facts involved in an individual case and are subject to change as scientific knowledge and technology advance and as practice patterns evolve.

It is important that you read the above information carefully and have all of your questions answered before signing the following consent.

CONSENT FOR SURGERY/PROCEDURE OR TREATMENT

1. I hereby authorize Dr. ___________________________ and such assistants as may be selected to perform the following procedure or treatment: ____. I have received the informed consent information sheet.
2. I recognize that during the course of the operation and medical treatment or anesthesia unforeseen conditions may necessitate different procedures than those listed above. I therefore authorize the above physician and assistants or designees to perform such other procedures that are in the exercise of their professional judgment necessary and desirable. The authority granted under this paragraph shall include all conditions that require treatment and are not known to my physician at the time the procedure is begun.
3. I consent to the administration of such anesthetics considered necessary or advisable. I understand that all forms of anesthesia involve risk and the possibility of complications, injury, and sometimes death.

4. I acknowledge that no guarantee has been given by anyone as to the results that may be obtained.
5. I consent to the photographing or televising of the operation(s) or procedure(s) to be performed, including appropriate portions of my body, for medical, scientific, or educational purposes, provided my identity is not revealed by the pictures.
6. For purposes of advancing medical education, I consent to the admittance of observers to the operating room.
7. I consent to the disposal of any tissue, medical devices, or body parts that may be removed.
8. I authorize the release of my Social Security Number to appropriate agencies for legal reporting and medical device registration, if applicable.
9. It has been explained to me in a way that I understand:
   a. The above treatment or procedure to be undertaken
   b. Alternative procedures or methods of treatment
   c. Risks of the procedure or treatment proposed

I CONSENT TO THE TREATMENT OR PROCEDURE AND THE ABOVE-LISTED ITEMS (1-9). I AM SATISFIED WITH THE EXPLANATION.

____

Patient or person authorized to sign for patient

____________________ ______________________________

Date Witness

CLINICAL ASSESSMENT

Meticulous documentation of the nasal history and anatomic findings is essential. A comprehensive nasal history helps determine whether a patient is medically and physically able to undergo rhinoplasty. A systematic anatomic examination is also a key factor. The surface anatomy of the nose directly reflects the underlying framework and is carefully evaluated; nasal skin thickness and texture have an effect on the rhinoplasty outcome. The soft tissue envelope is inspected to evaluate its overall condition, and the thickness of the nasal tip skin is assessed. The internal nasal examination confirms the presence of any existing functional deformity.

Systematic Nasal Analysis

Systematic nasal analysis plays a key role in achieving nasofacial harmony after rhinoplasty. This system allows systematic and comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.

Systematic Nasal Analysis

Frontal View

Facial proportions

Skin type/quality: Fitzpatrick type, thin or thick, sebaceous

Symmetry and nasal deviation: Midline, C-, reverse C-, S- or S-shaped deviation

Bony vault: Narrow or wide, asymmetrical, short or long nasal bones

Midvault: Narrow or wide, collapsed, inverted-V deformity

Dorsal aesthetic lines: Straight, symmetrical or asymmetrical, well or ill defined, narrow or wide

Nasal tip: Ideal/bulbous/boxy/pinched, supratip, tip-defining points, infratip lobule

Alar rims: Gull-wing shaped, facets, notching, retraction

Alar base: Width

Upper lip: Long or short, dynamic depressor septi nasi muscles, upper lip crease

Lateral View

Nasofrontal angle: Acute or obtuse, high or low radix

Nasal length: Long or short

Dorsum: Smooth, humped, scooped out

Supratip: Break, fullness, pollybeak

Tip projection: Overprojected or underprojected

Tip rotation: Overrotated or underrotated

Alar-columellar relationship: Hanging or retracted alae, hanging or retracted columella

Periapical hypoplasia: Maxillary or soft tissue deficiency

Lip-chin relationship: Normal, deficient

Basal View

Nasal projection: Overprojected or underprojected, columellar-lobular ratio

Caudal septal deviation

Nostril: Symmetrical or asymmetrical, long or short

Columella: Septal tilt, flaring of medial crura

Alar base: Width

Alar flaring

Systematic nasal analysis allows comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.

A thorough understanding of an individual patient's nasal and facial proportions is an absolute prerequisite to successful rhinoplasty. Facial proportions must always be considered, because the nose is a prominent component of the overall facial characteristics.

Standardized Photography

Additional documentation is provided by standardized photographic views taken preoperatively that can be compared with postoperative views (see Chapter 5). Analysis of the patient's nasal/facial photographs is essential to rhinoplasty planning as well as for before and after documentation for medicolegal purposes.

Preoperative photographs help identify nonideal nasal/facial anatomic lines and landmarks. Computer images are generated to compare these photographic lines and landmarks with the ideal that the surgical plan is designed to achieve. An operative plan is then outlined on the rhinoplasty worksheet (see p. 1426) and taken to the operating room with the patient's photographs and computer images.

Computer imaging has been a useful adjunct to rhinoplasty. It is especially helpful for evaluating secondary rhinoplasty patients and determining whether they have realistic expectations for future surgery. It allows simulation of the nasal changes seen after rhinoplasty and enables the patient to visualize the projected surgical results before surgery. It also gives the patient an active role in determining what aesthetic goal is ideal and what surgical results are possible. For the surgeon, it is another means of building a bond with the patient and enhancing communication. It also helps identify potential red-flag patients. If the patient is unhappy with the imaging projections or requests something that is not possible or not aesthetically pleasing or proportional, do not operate!

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RHINOPLASTY WORKSHEET

HISTORY

Nasal illness ______________________
Allergies ______________________
Trauma ______________________
Previous operations ______________________
Respiratory problems ______________________
Cardiovascular disease ______________________
Bleeding disorders ______________________
Familial diseases ______________________
Drugs currently used ______________________
Drug allergies ______________________
Emotional/psychological problems ______________________
Miscellaneous ______________________

ANATOMIC EXAMINATION

Dorsum ______________	Base ______________
Radix ______________	Columella ______________
Height ______________	Alar flare ______________
Width ______________	Interalar width ______________
Other ______________	Other ______________

Tip ______________	Internal ______________	Miscellaneous ______________
Projection ______________	Internal valve ______________	Maxilla ______________
Domes ______________	Septum ______________	Occlusion ______________
Lobular angle ______________	Turbinate ______________	Chin ______________
Labial angle ______________	Other ______________	Other ______________
Other ______________		

REMARKS

IMPRESSIONS

1. ______________________
2. ______________________
3. ______________________
4. ______________________
5. ______________________

GOALS	OPERATIVE PLANS
1. ______________	1. ______________
2. ______________	2. ______________
3. ______________	3. ______________
4. ______________	4. ______________

OPERATIVE TECHNIQUE

We follow a general operative sequence for most cases and vary it as necessary.

Operative Sequence

1. Anesthesia and patient positioning
2. Incisions (transcolumellar and bilateral infracartilaginous)
3. Soft tissue elevation/dissection of lower lateral cartilage/upper lateral cartilage
4. Intraoperative diagnosis
5. Assessment of tip projection
6. Component dorsal reduction/dorsal augmentation
7. Septal reconstruction/cartilage graft harvest (if indicated)
8. Inferior turbinate surgery (if indicated)
9. Reconstitution of nasal dorsum
10. Upper lateral cartilage tension-spanning sutures
11. Autospreader flaps (if indicated)
12. Spreader grafts (if indicated)
13. Manipulation of lateral crura (if indicated)
14. Cephalic trim (if indicated)
15. Lower lateral crural turnover flaps (if indicated)
16. Transnasal division of depressor septi nasi muscle (if indicated)
17. Establish final tip projection (columellar strut graft–tip-suturing-techniques, tip, grafts)
18. Alar contour grafts (if indicated)
19. Osteotomies
20. Final inspection/irrigation
21. Wound closure
22. Transoral depressor septi nasi muscle dissection and transposition (if indicated)
23. Medial crural footplate reapproximation sutures (if indicated)
24. Alar base surgery
25. Splints and dressings

Anesthesia and Patient Positioning

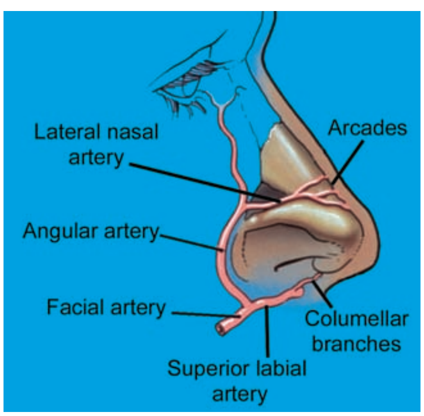
Patient positioning on the operating room table is essential to maximize comfort and control. The patient should be positioned with the head and body on the side of the table closest to the surgeon, with the patient's head slightly over the top of the table to gently extend the patient's neck and minimize any excessive neck flexion or lower back strain for the surgeon. For example, for a left-handed surgeon, the patient will be positioned toward the left side of the table. The table should be brought up to a height that allows the surgeon optimal access with both hands while minimizing strain on the neck or back.

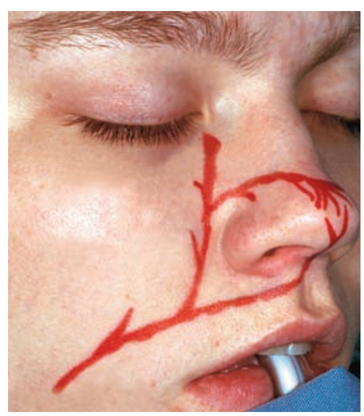
We prefer to use general anesthesia. Following induction of a general anesthetic with endotracheal intubation, a moistened throat pack is inserted into the oropharynx to prevent intragastric blood during the procedure, which contributes to postoperative nausea and vomiting. In addition, it prevents blood from collecting at the laryngopharynx, which can cause laryngeal irritation with coughing or laryngospasm.

We use a solution of 10 to 15 ml of 1% lidocaine with 1:100,000 epinephrine to infiltrate both the soft tissue envelope and the intranasal mucosa. Injection begins posteriorly in the nasal septal mucosa in a submucoperichondrial plane, proceeding in a posterior-to-anterior direction, and includes the mucosa along the entire vertical height of the septum. Next the soft tissue envelope is infiltrated. The plane of injection is deep between the soft tissue envelope and the osteocartilaginous nasal framework. The soft tissues are typically infiltrated until they appear tense, and this seems to help with both hemostasis and dissection. Care is taken to infiltrate evenly.

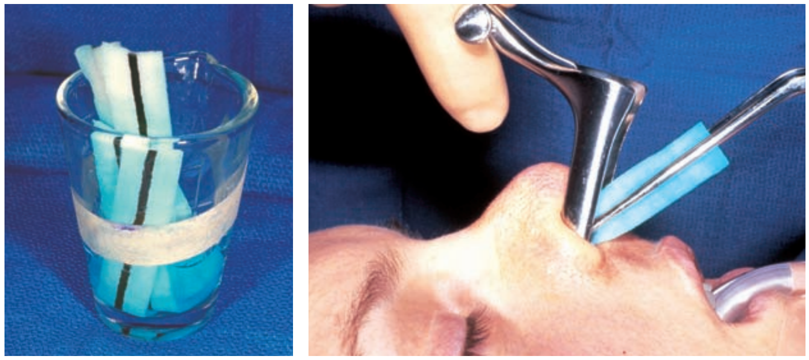
Location/Volume Distribution of 1% Lidocaine With 1:100,000 Epinephrine

Location	Amount (ml)
Vestibules/aperture	2-3
Dorsum	1-3
Lateral walls	2-3
Tip/columella	2-3
Distal septum	2
Inferior turbinates	1
TOTAL	10-15



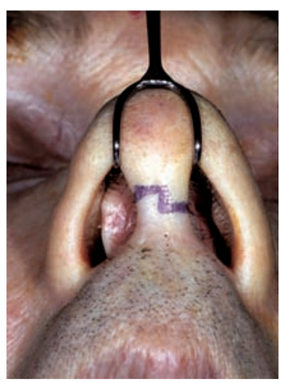


Particular attention is paid to highly vascular anatomic subunits, including the midcolumella, lateral nasal walls and dorsum, nasal tip, and alar base, and intranasally along the caudal margin of the lower lateral cartilages. The anterior head of the inferior turbinate is injected if inferior turbinate surgery is anticipated.

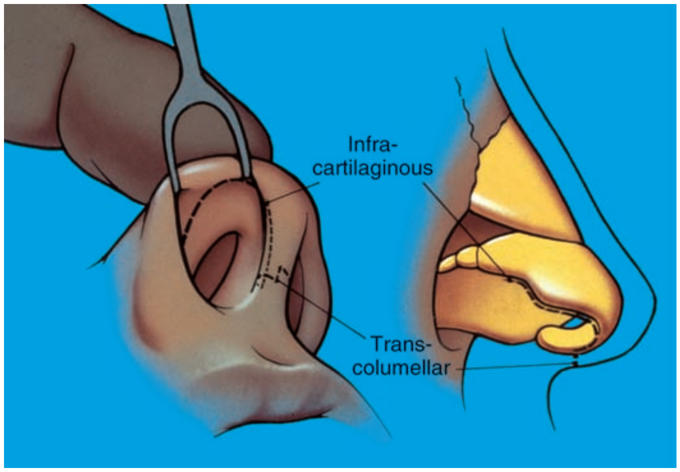


After infiltration of the local anesthetic is completed, oxymetazoline-soaked cottonoid pledgets are placed into both nasal cavities. One drop of methylene blue is placed into the solution to visually differentiate it from the local anesthetic. Three pledgets are placed on each side along the middle turbinate, inferomedial septum, and superior nasal vault. Vasoconstriction of these areas provides maximal internal nasal visualization. Since the inferomedial septum houses the sphenopalatine vessels, vasoconstriction is especially important in this area. We prefer oxymetazoline over cocaine as a vasoconstrictive agent, because this avoids the potential for idiosyncratic adverse reactions that have been associated with the use of cocaine. Equivalent mucosal shrinkage is achieved without the use of a controlled substance. Engorgement of the nasal mucosa or a significant septal spur obscures the view of the intranasal vault.

Transcolumellar and Bilateral Infracartilaginous Incisions



A transcolumellar stair-step incision is made at the narrowest part of the columella, generally near its midportion. This is done superficially to prevent injury to the underlying medial crura. A broken line incision is used to camouflage the scar, to provide landmarks for accurate closure, and to prevent linear scar contracture.



The incision is continued intranasally through an infracartilaginous incision, which approximates the caudal border of the medial crura. This incision is continued toward the apex of the middle crus. A separate incision is begun laterally in the vestibule along the caudal margin of the lateral crus of the lower lateral cartilage.

The caudal margin of the lateral crus is revealed by everting the ala using external digital pressure against a double skin hook placed within the alar rim. The inferior border is visibly evident using this maneuver or can be palpated using the back of the scalpel handle. The incision is extended in a lateral-to-medial direction, staying along the caudal cartilage margin. The two incisions are connected at the middle crus region.

Soft Tissue Envelope Dissection

The soft tissue envelope is elevated in a supraperichondrial plane up to the bony pyramid. This is a combination of sharp and spreading dissection. The periosteum is sharply incised and elevated with a Joseph periosteal elevator, and dissection is continued superiorly in a subperiosteal plane to the radix area. The subperiosteal dissection should be limited to the central third of the bony vault to allow bony hump reduction if indicated while preserving the lateral soft tissue attachments. If osteotomies are performed, these soft tissue attachments will provide stability to the osteotomized segments.

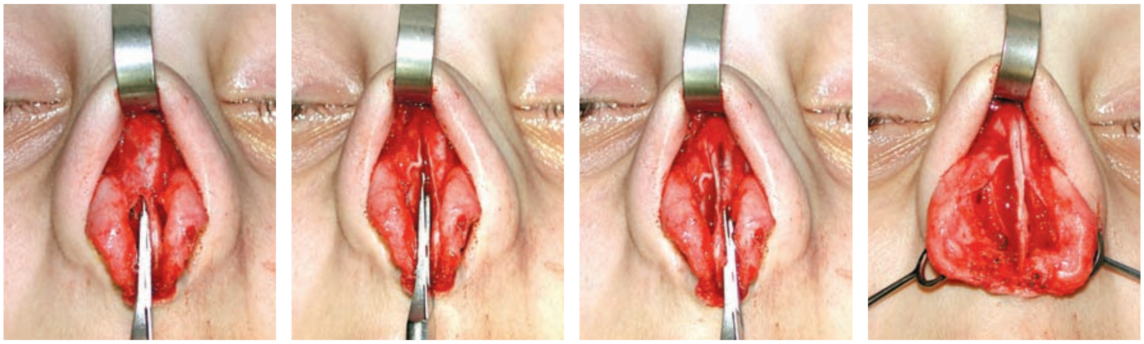
Once the underlying osteocartilaginous framework has been exposed, it is possible to assess for structural abnormalities that require correction. This will confirm the cause of the external deformities observed on preoperative clinical analysis.

Component Dorsal Reduction

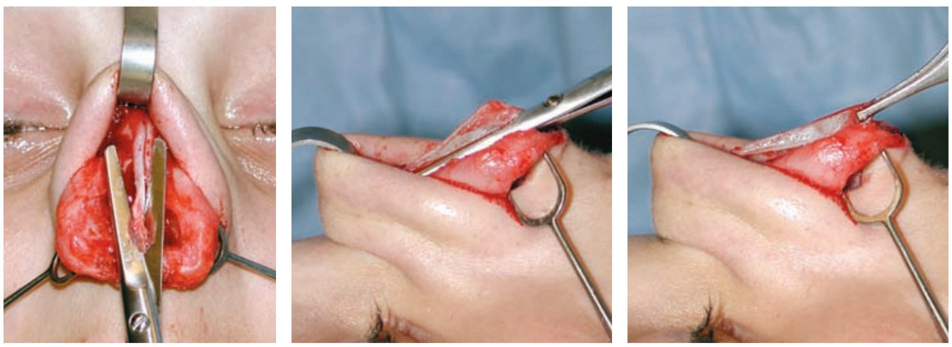
Before the dorsal height is adjusted, the surgeon assesses tip projection. When tip projection is adequate, the dorsum is adjusted to create ideal nasal dorsum-tip balance. In some instances, the dorsal height is adequate and tip projection needs to be adjusted.

In the past, the approach to the dorsum—using a composite dorsal hump reduction technique—was likely the source of many postoperative problems at the midvault. Excess cartilage removal at the midvault leads to poorly defined dorsal aesthetic lines and can also cause problems with the internal nasal valves.

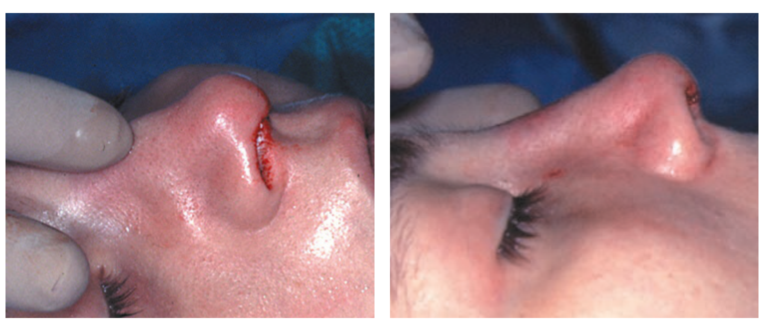
We have evolved a component approach to the dorsum to prevent these undesirable problems. It involves the following:



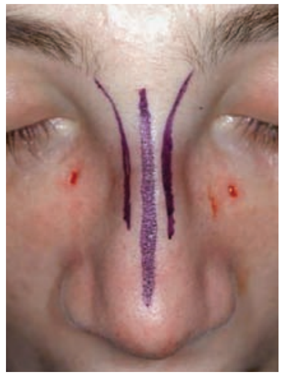
1. Release of the upper lateral cartilages from the dorsal septum



2. Resection of the dorsal septum incrementally

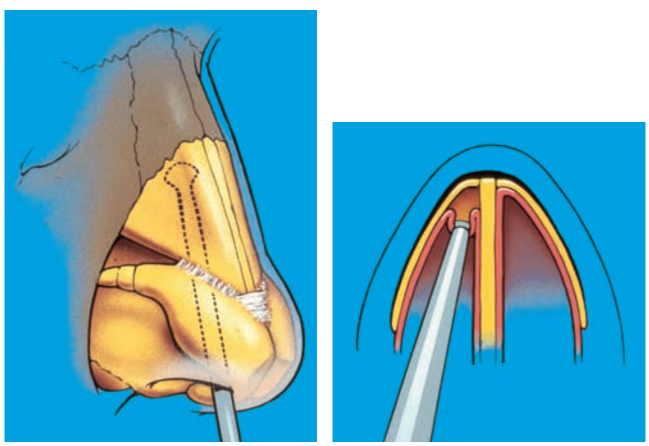


3. Rasping of the bony dorsum

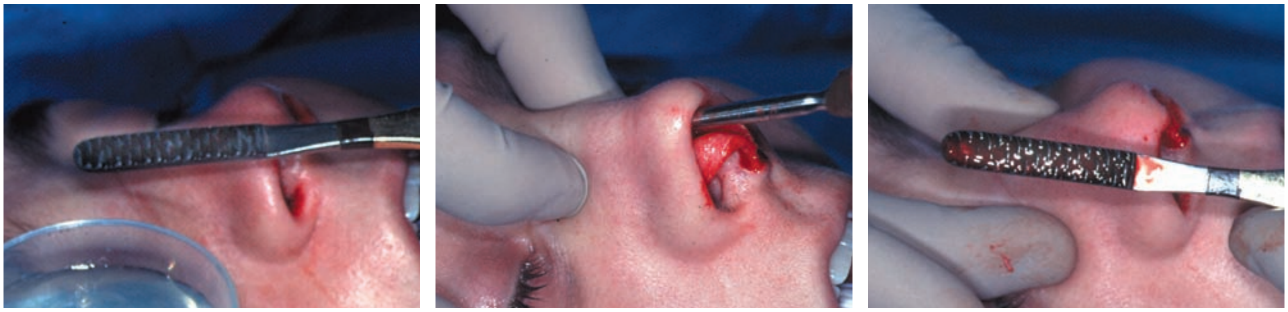


4. Restoration of the dorsal aesthetic lines

We prefer to reduce the cartilaginous septum after separating the upper lateral cartilage and before performing bony dorsum reduction. The cartilaginous dorsum is reduced initially as a separate component by lowering the septum and upper lateral cartilages in an extramucosal manner. It is important to maintain as much periosteal attachment of the bony sidewall as possible because it provides significant external support for the nasal pyramid following osteotomy.



An extramucosal approach is ensured by initially creating submucosal tunnels using the dorsal septal approach and proceeding beneath the osteocartilaginous roof before modifying the bony dorsum. This minimizes late scarring, which could lead to subsequent internal nasal valve dysfunction, and provides a closed space for safe placement of spreader or dorsal grafts.



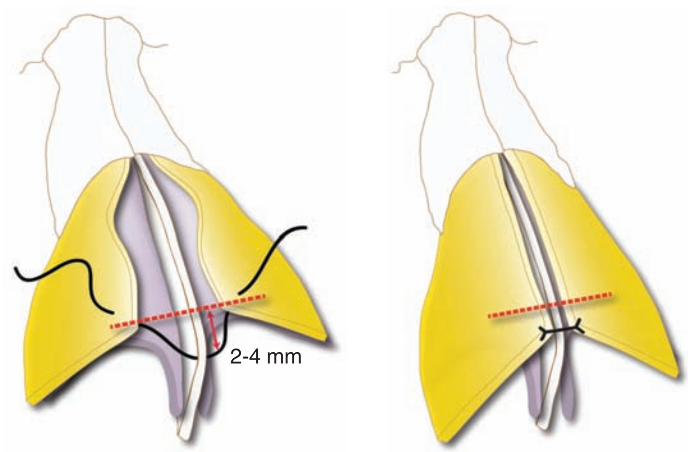
Dorsal bony humps are managed according to their size. In general, small to medium dorsal humps (less than 5 mm) are reduced by simple rasping. Rasping should be performed using short strokes, with the nondominant index finger and thumb stabilizing the bony vault for maximal control. Rasping is done at an oblique angle to prevent mechanical avulsion of the upper lateral cartilage. We prefer to use a sharp down-biting Forman diamond rasp. The superior edge of the upper lateral cartilage that projects under the nasal bone may require trimming to avoid lateral fullness after rasping.

Large dorsal bony humps (greater than 5 mm) are expediently managed using sharp resection with a guarded osteotome. The sharp guarded osteotome is placed at the desired level along the caudal margin of the bony pyramid and carefully driven to a predetermined point superiorly. The skin envelope is replaced and a three-point test performed. The newly contoured nasal dorsum is moistened to allow a finger to glide smoothly across the skin.

The midsagittal dorsum is palpated along its length and on either lateral side to determine whether the nasal dorsum is smooth and straight. After the dorsal septum is trimmed to its desired height, septal reconstruction and inferior turbinate surgery is performed (described later) before reconstitution of the midvault.

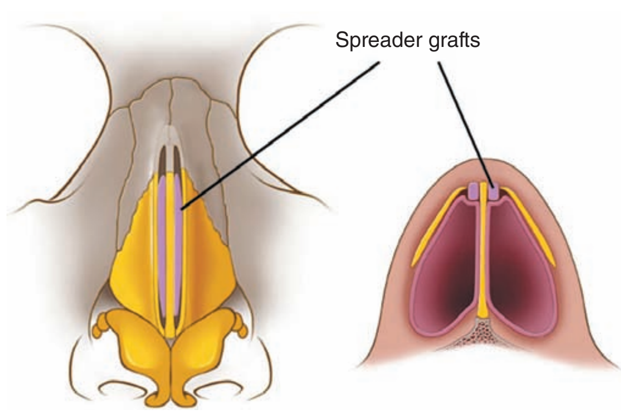
Preserving the upper lateral cartilages allows reconstitution of the midvault and restoration of the dorsal aesthetic lines and internal nasal valve. The upper lateral cartilages can be resected independent of the dorsal septum, or the upper lateral cartilages can be used as autospreader flaps.

Upper Lateral Cartilage Tension-Spanning Sutures



Upper lateral cartilage tension-spanning sutures are used to reconstitute the midvault. Preservation of the cartilage has decreased the requirement for spreader grafts to reconstruct the midvault and internal valve. In primary rhinoplasty, indiscriminate use of spreader grafts will lead to excessive midvault width, visibility/palpability, and depletion of cartilage required for grafting elsewhere.

Spreader Grafts

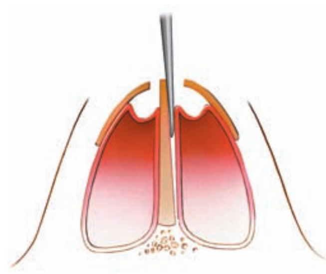


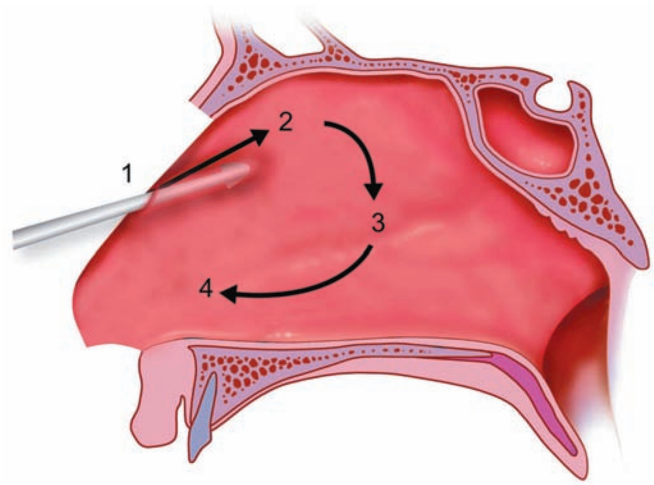
In primary rhinoplasty, spreader grafts are required if the dorsal aesthetic lines are too narrow; or, more commonly, for correction of the deviated nose, unilateral placement of spreader grafts can be used to camouflage residual concavities of the dorsum. The mucoperichondrium is elevated bilaterally 4 to 6 mm from the dorsal septal edge. The mucoperiosteum is also elevated from the undersurface of the nasal bones medially and from the perpendicular plate of the ethmoid. Septal cartilage grafts are preferred and are contoured to measure 25 to 30 mm long and 3 mm wide. The dorsal cephalic edges of the grafts are resected obliquely to allow them to be seated under the bony dorsum. The grafts are placed and su-

tured to the dorsal septum with two through-and-through horizontal mattress sutures of 5-0 PDS. If lengthening of the nose is desired, the caudal ends of the grafts are left long to extend past the anterior septal angle. However, if lengthening is not desired, the grafts should end at the level of the anterior septal angle. The spreader grafts can also be placed higher (visible) or lower (invisible) along the dorsal septum, depending on the clinical situation. Final dorsal trimming is carried out after the osteotomies are performed to infracture the nasal bones.

Dorsal hump reduction commonly results in a significant open roof deformity that will require percutaneous perforated lateral osteotomies to close the open dorsum (described later).

Septal Reconstruction/Cartilage Graft Harvest



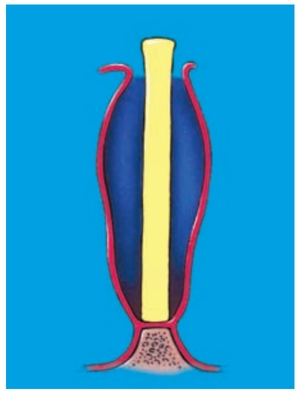


If septal cartilage harvest or septal reconstruction is indicated, the interdomal suspensory ligament is incised to expose the anterior septal angle.

A No. 15 blade scalpel is used to score the perichondrium about 3 mm posterior to the anterior septal angle until the underlying cartilage is exposed.

Initially, a Cottle elevator is used to elevate the mucoperichondrial flap in a posterior and superior direction. This submucoperichondrial plane is identified by the distinct gray-blue appearance of the cartilage, its gritty feel, and by the relative

lack of resistance. Once in the submucoperichondrial plane, dissection proceeds quite easily. If there is resistance, this is usually because the plane of dissection is slightly superficial, and the perichondrium should be scored again so elevation of the flap is performed in the correct plane. Elevation of the mucoperichondrial flap in a superficial plane will lead to a greater likelihood of mucosal perforations.



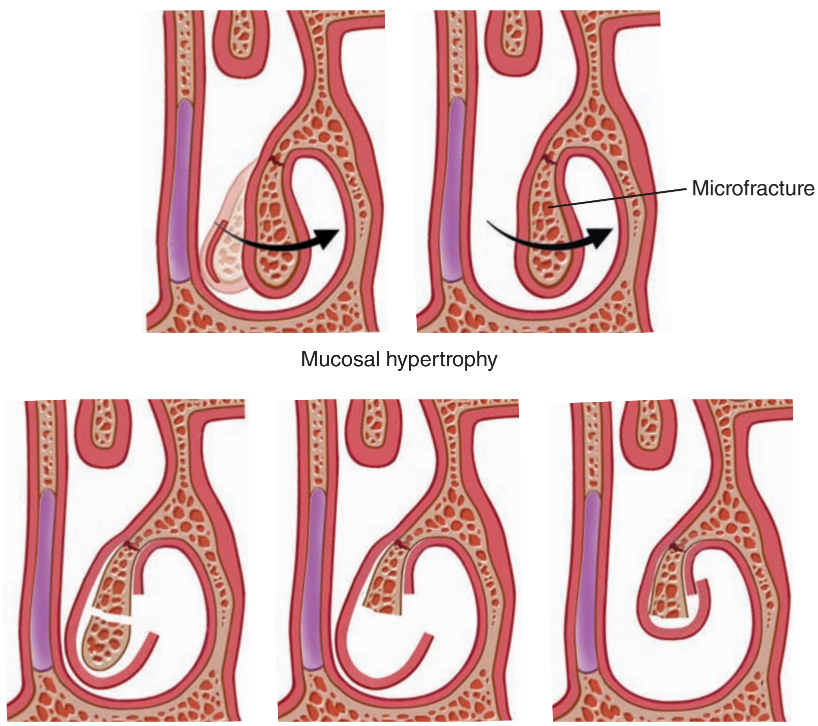
Bilateral submucoperichondrial tunnels are dissected deep to the upper lateral cartilages, and a scalpel is used to separate the upper lateral cartilages from the dorsal septum. Release of the upper lateral cartilages from the dorsal septum allows direct visualization of the entire dissection. The submucoperichondrial dissection should be continued bilaterally to release the entire quadrangular cartilage.

When harvesting the septal cartilage, an incision is made parallel to the anterior edge of the septum, from the junction of the dorsal L-strut with the perpendicular plate of the ethmoid to the junction of the caudal L-strut with the maxillary crest. The width of the L-strut is determined by the strength of the cartilage. The dorsal and caudal L-strut should be at least 10 mm, but in many instances a width of 15 mm or more may be required to ensure long-term support. The L-strut should remain attached to the perpendicular plate at the keystone area and the anterior nasal spine–maxillary crest area. In addition, curving the transition points between the perpendicular plate of the ethmoid and the dorsal L-strut and, also, between the dorsal and caudal L-strut can help to strengthen the construct.

Only the amount of septal cartilage, and sometimes bone, needed for grafting or that which is obstructing the nasal cavity is removed. If only a small amount of septal cartilage is required, the L-strut should be left even wider than 15 mm. The excised cartilage is placed in saline solution. Ideally, no mucosal tears are created, avoiding the need for repair and potential septal perforation. The opposing mucoperichondrial flaps can be reapproximated by placing Doyle splints at the time of nasal closure.

Inferior Turbinate Surgery

At this point, the cottonoid pledgets are removed from both nasal cavities. Mucosal hypertrophy of the inferior turbinates will have regressed with oxymetazoline treatment. If there is no bony inferior turbinate hypertrophy, outfracture of the inferior turbinates is performed to open the nasal airway. If bony inferior turbinate hypertrophy exists, submucosal microfracture and submucosal resection of the anterior inferior turbinates is performed.



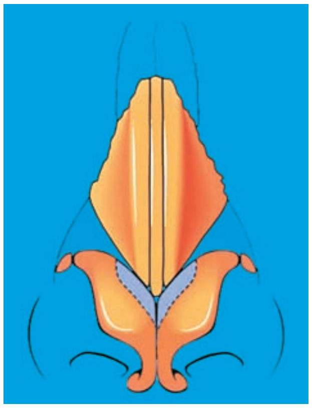
Bony hypertrophy

Pinpoint electrocautery is used to incise along the inferior margin of the turbinate down to conchal bone. A medial mucoperiosteal flap is elevated with a Cottle elevator to expose the desired amount of turbinate to be resected. Takahashi forceps are used to microfracture, morselize, and gently remove the conchal bone. The mucoperiosteal flap is laid back down, taking care to cover the cut edge of

the turbinate. Failure to cover the cut edge of conchal bone may lead to postoperative crusting and/or epistaxis. No sutures are necessary for closure because the mucoperiosteal flap will adhere to the remaining underlying bone.

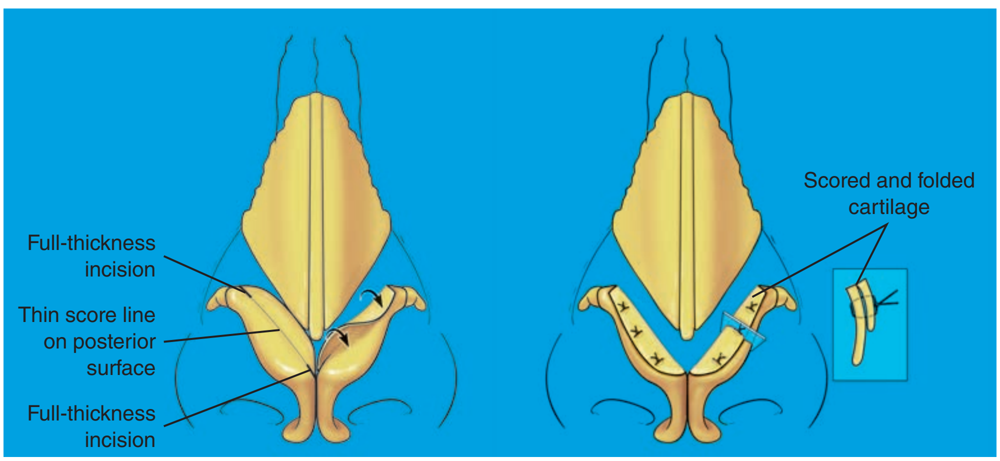
Manipulation of Lateral Crura

Cephalic Trim



Only when the domes are bulbous or boxy, causing paradomal fullness, is a cephalic trim indicated. The cephalic portion of the middle and lateral crura of the lower lateral cartilage is modified leaving at least a 5 mm rim strip. Calipers are used to accurately demarcate the planned incision. Excised lower lateral cartilage is used for tip or alar grafting when indicated.

Lower Lateral Crural Turnover Flaps

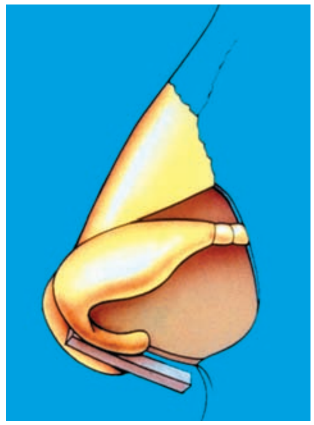


Rather than cephalic trim of the lateral crura, the lower lateral crural turnover flap can be used to preserve this cartilage and use it to correct concavities/convexities of the lower lateral crus, strengthen the external valve, and oppose pinching of the tip from tip suturing. This exploits the intrinsic concavities/convexities of the lateral crus and repositions these forces into opposition, resulting in correction of the deformity. This flap is particularly useful when the lower lateral cartilages appear weak and helps to reduce tip fullness while making use of the intrinsic strength of the lower lateral cartilages.

Nasal Tip Suture Techniques and Grafting

A graduated approach to nasal tip surgery involves the use of a columellar strut graft, suture techniques, and tip grafts.

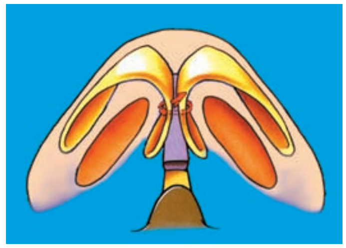
Columellar Strut Graft



The columellar strut graft is used to unify the tip complex and maintain tip projection. Columellar strut graft placement using the open approach allows a greater increase in tip projection because of the ability to release the lower lateral cartilages and reestablish them in a more projecting position on the strut. A pocket is created between the feet of the medial crura, and a soft tissue layer is preserved on the premaxilla to avoid a strut seated directly on nasal spine bone. The columellar strut graft can be placed in an invisible position by dissecting the pocket closer to the caudal septum superiorly. If changes in the shape of the columella, alteration of the alar-columellar relationship, and/or columellar-labial transition are desired, this pocket can be dissected closer to the columellar skin. The columellar strut is placed into the pocket with Brown-Adson forceps and is pushed toward the anterior nasal spine to ensure that it is resting in the bottom of the pocket.

Double-pronged skin hooks that are secured in each vestibular apex are used to maintain the tip in the desired position while the medial crural–columellar strut 5-0 PDS sutures are placed. Typically three or four sutures are used to secure the medial crura to the columellar strut and unify the tip complex. The strut is then trimmed to its desired shape to alter or refine the infratip lobular area.

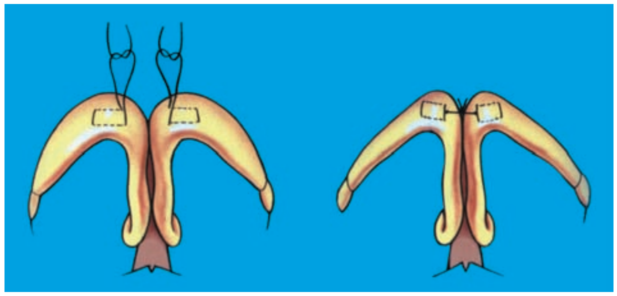
Nasal Tip Suture Techniques



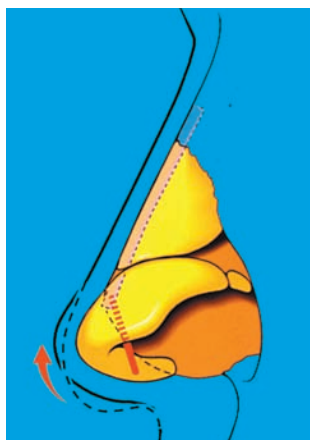
Four primary suture techniques are commonly used. Medial crural–columellar strut sutures stabilize the columellar strut graft between or in front of the medial crura, as just described.

Interdomal sutures can increase infratip-columellar projection and definition or further increase tip projection. A simple 5-0 PDS suture is placed through the medial walls of the domes and tied to narrow the interdomal distance.

Transdomal sutures control dome asymmetry. A 5-0 PDS horizontal mattress suture is placed from the medial surface of the dome through the lateral surface, staying deep to the vestibular skin. It is passed back from lateral to medial. A double surgeon's knot is placed in the suture and tightened until the desired dome angulation is achieved.



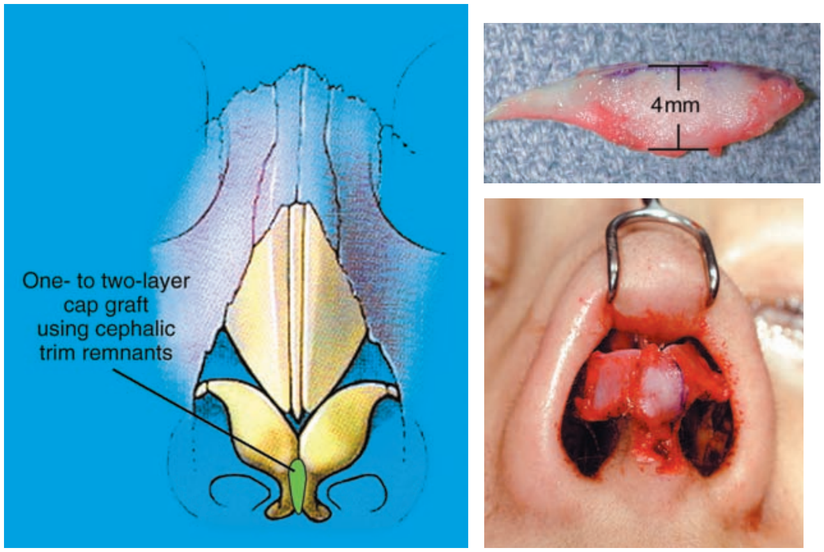
If narrowing of the distance between the tip-defining points is required, one end of the suture is cut short and the other is left approximately 1 inch long. The same procedure is performed on the opposite side, leaving one end of the suture long. The long end is tied to the remaining suture end on the opposite side. The knot is tightened until the desired distance exists between the tip-defining points and then tied.



Finally, tip rotation is altered using medial crural septal sutures. Medial crural septal sutures secure the middle crura to the caudal septum and can be used to reduce or increase tip projection and rotation.

Nasal Tip Grafts

Only if adequate tip projection, definition, or symmetry cannot be obtained using the previous procedures are tip grafts used. Invisible tip grafts are preferred over visible tip grafts because visible grafts can reabsorb and become asymmetrical and/or sharply angulated over the long term, necessitating revision.

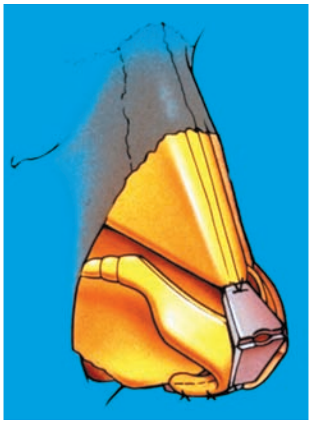


Invisible tip grafts including the anatomic cap graft and morselized cartilage onlay grafts are used if a small degree of tip contouring or volume augmentation is desired after tip suturing is completed. Cartilage resulting from the cephalic trim of the lower lateral cartilage can be used to fashion an anatomic cap graft. This cartilage graft is typically thin and pliable so it contours over the tip very well and it does not have any distinct edges so palpability and/or visibility of the graft is not a problem.

In areas that require minimal augmentation or improvement of mild irregularities of the osteocartilaginous framework, morselized cartilage onlay grafts can be placed. The cartilage is morselized in a cartilage crusher and can range from being slightly bruised (to make it less rigid and more conforming without sharp edges) to crushed into a thin sheet (that can act as a scaffolding for tissue ingrowth). Morselized cartilage onlay grafts can be used anywhere for augmentation or correction of mild irregularities. We have most commonly used it as a tip graft or along the dorsum for dorsal irregularities.

Visible tip grafts including infralobular, onlay, and combination grafts can be used if more structural support is required to achieve the desired tip projection or shape. The infralobular graft primarily increases infratip lobular definition and tip projection. These grafts are variably shaped, depending on the nasal tip anatomy and requirements, but they must have smooth, tapered edges. A shield-shaped graft is cut from septal cartilage so that the superior aspect of the graft is approximately 8 mm wide. The width of the base of the graft is the same as the distance between the caudal margins of the medial crura. The length of the graft is 10 to 12 mm. The graft is placed so that it extends 2 to 3 mm beyond the tip-defining points. To reduce the incidence of secondary revision, removing the sharp edges of the graft and securing the tip graft in place with at least two 5-0 PDS sutures at the caudal margins of the dome and medial crura should be performed. Usually three sutures are required to stabilize the graft.

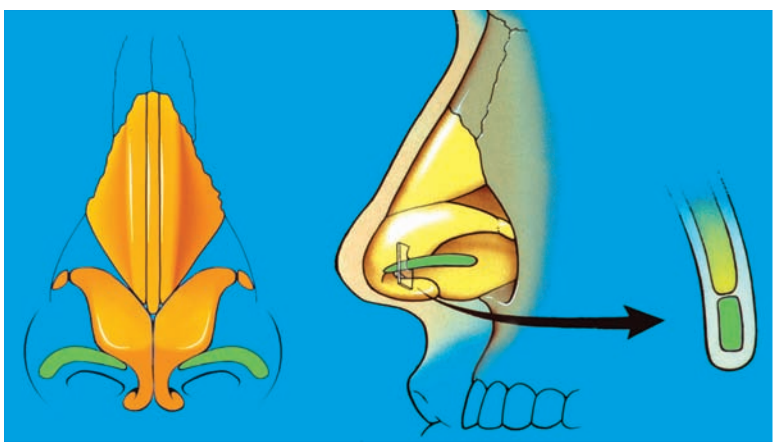
Onlay tip grafts increase tip projection and tip definition. A 6 by 8 mm onlay tip graft is contoured from the septal cartilage and stabilized with two 5-0 PDS sutures to the tip-defining points of the dome. The sutures are placed in a horizontal mattress fashion with the knots tied on the underside of the dome areas.



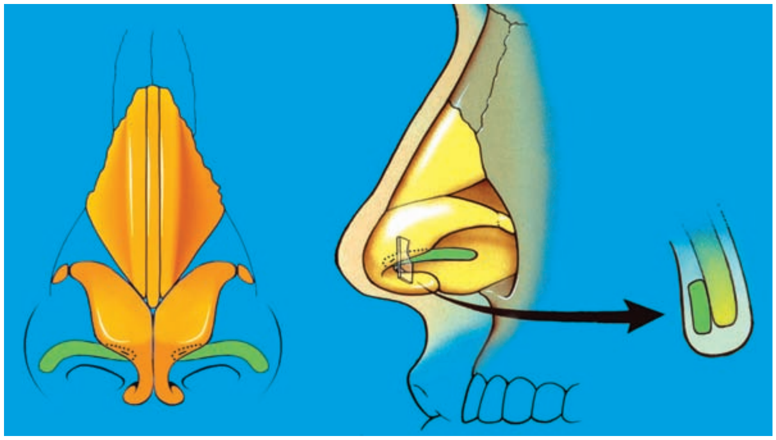
Additionally, the columellar strut, infratip lobular, and/or onlay tip cartilage grafts can be fashioned into a combination graft. This visible graft is reserved for the difficult primary rhinoplasty patient with inadequate tip projection, the thick-skinned patient, and the secondary rhinoplasty patient with inadequate tip projection.

Alar Contour Grafts

The lower lateral cartilage is the structural cornerstone for the alar rim and overall tip support. However, it is the strength, anatomic positioning, and orientation of the lateral crus that are paramount to the location, contour, and stability of the ala. External valve collapse, notching, and retraction can all become apparent when the lateral crus is unable to provide proper support for nasal soft tissues that become further stressed with inspiratory effort. In patients with alar rim collapse or weakness, the soft triangle appears notched from lack of underlying cartilaginous support.



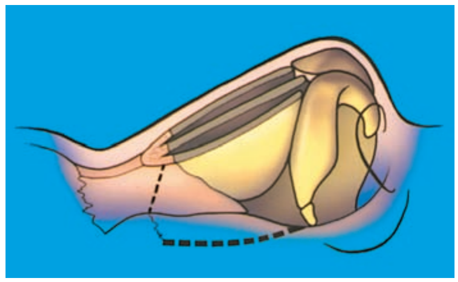
For the past two decades, we have used alar contour grafts as a simple yet effective rhinoplasty technique for improved contouring of the alar rim that involves the nonanatomic insertion of an autologous cartilage graft into a pocket along the alar rim. The alar contour graft provides a foundation for reestablishment of a normally functioning external nasal valve, and an aesthetically pleasing nasal tip and alar contours. Use of alar contour grafts decreases the risk of alar deformities including alar notching or retraction, as well as excessive concavity or convexity of the alar rim.



More recently, the extended alar contour graft has been used to prevent notching of the anterior alar rim where the lateral crus begins to diverge from the alar rim as it courses to the pyriform aperture. Additionally, the extended alar contour graft can influence the rotational orientation of the lateral crus so that the caudal and cephalic borders are rotated into the same horizontal plane further influencing the tip and alar contours.

Percutaneous Perforated Lateral Osteotomies

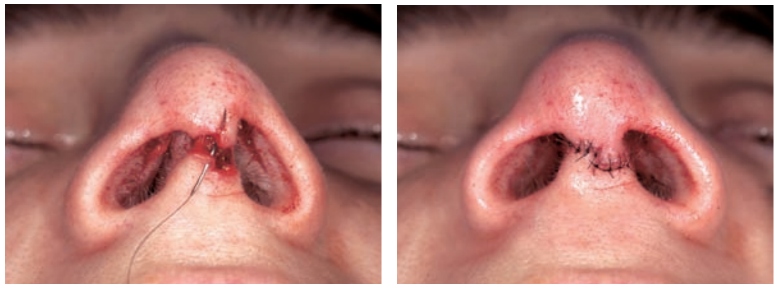
Nasal osteotomies are performed to narrow a wide bony vault, to close an open roof defect, or to straighten deviated nasal bones. We prefer a percutaneous perforated lateral osteotomy using a 2 mm osteotome through a lateral stab incision. The incision is placed in the respective nasofacial groove and swept laterally to the bony nasofacial groove to avoid injury to the angular vessels.



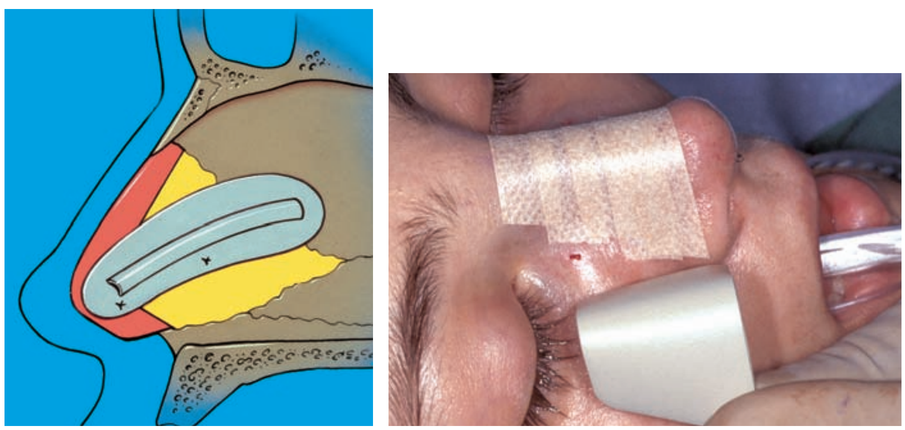
A discontinuous, low-to-low, lateral osteotomy is performed inferiorly—preserving Webster's triangle at the piriform aperture—to superiorly at the level of the medial canthus. A superior oblique osteotomy is then done. Gentle digital infracture is performed to reposition the osteotomized segments. The soft tissue attachments preserved during the initial elevation of the soft tissue envelop will provide stability to the osteotomized segments. After osteotomies, it is important to reevaluate the dorsum for any irregularities.

Closure

All debris is carefully removed before closure by irrigating with a bulb syringe of normal saline solution. The osteocartilaginous contour should be inspected for a smooth, harmonious appearance. A final three-point test of the dorsal contour is performed, and any irregularities or depressions that are found are corrected with morselized cartilage onlay grafts. The soft tissue envelope is redraped and the supratip break is reassessed.

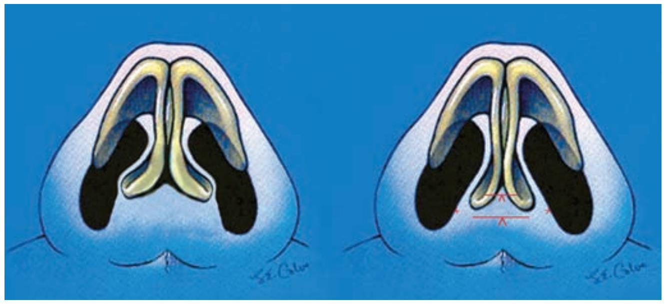


A 6-0 black nylon suture on a PC-3 needle is used to close the transcolumellar incision centrally with two sutures at the stair-step incision, followed by a lateral vestibular margin suture. Meticulous closure is performed to prevent notching or a noticeable scar, particularly at the vestibular margin when performing the final closure after open rhinoplasty. The infracartilaginous incision is closed with a 5-0 chromic suture on a PC-3 needle using interrupted sutures. Particular care is taken to reapproximate the mucosa at the middle crural region. Poor healing or inadequate closure in this area can result in distorting the soft triangle and infratip area as well as a web deformity.



Doyle internal nasal splints coated with an antistaphylococcal ointment are placed and fixed anteriorly with a transseptal 3-0 nylon suture. Dorsal taping of the soft tissue envelope starts at the supratip break and proceeds to the radix; then a Denver dorsal nasal splint is placed. A 2 by 2 cm drip pad is affixed with ½-inch paper tape under the alar base and attached to the cheek. One-inch paper tape over the malar areas prevents skin maceration from frequent nasal dressing changes, especially for the first 2 to 3 days postoperatively. The throat pack is carefully removed, and the pharynx is suctioned to remove any pooled blood and secretions. This helps prevent postoperative nausea and a sore throat.

Medial Crural Footplate Reapproximation Sutures



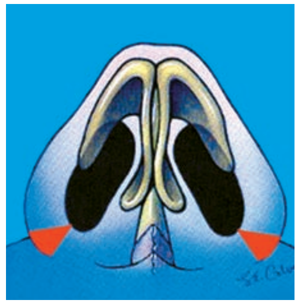
When deformities of the columella are secondary to medial crural abnormalities, medial crural footplate reapproximation sutures can be used to improve the aesthetics of the columellar base. Asymmetry resulting from excessive medial crural volume is treated with sharp excision of excess tissue. However, deformities of the medial crura can be treated with approximation of the medial crural footplates. Medial crural footplate approximation is used to improve the relationship between the medial crural footplates and the columellar base. A five-step approach is used:

1. The location and extent of splayed footplates are marked by two symmetrical lines that parallel the columella along the inferior medial portion of the nasal sill.
2. An excision of minimal mucosa (1 to 2 mm) overlying the marked area of medial crural footplates in performed.
3. A 5-0 PDS horizontal mattress spanning suture is passed through-and-through the demucosalized skin of the columella securing the medial crura footplates.
4. A second 4-0 chromic gut horizontal mattress suture can be used to approximate the soft tissue mass at the base of columella and the membranous septum.
5. Mucosal closure is performed with 5-0 chromic gut suture.

Alar Base Surgery

Abnormalities requiring alar base modification include alar flaring, large nostril size, excessive width of the nasal base, and asymmetries of the alae and/or nostrils. Alar base surgery is typically performed toward the end of the operation as many of these problems are intimately related to tip projection, alar rim contour, and columellar shape. Alar flaring is the most common indication for alar base modification. The measured alar plane and the nostril circumference will dictate the surgical approach.

Alar Flaring Correction Only



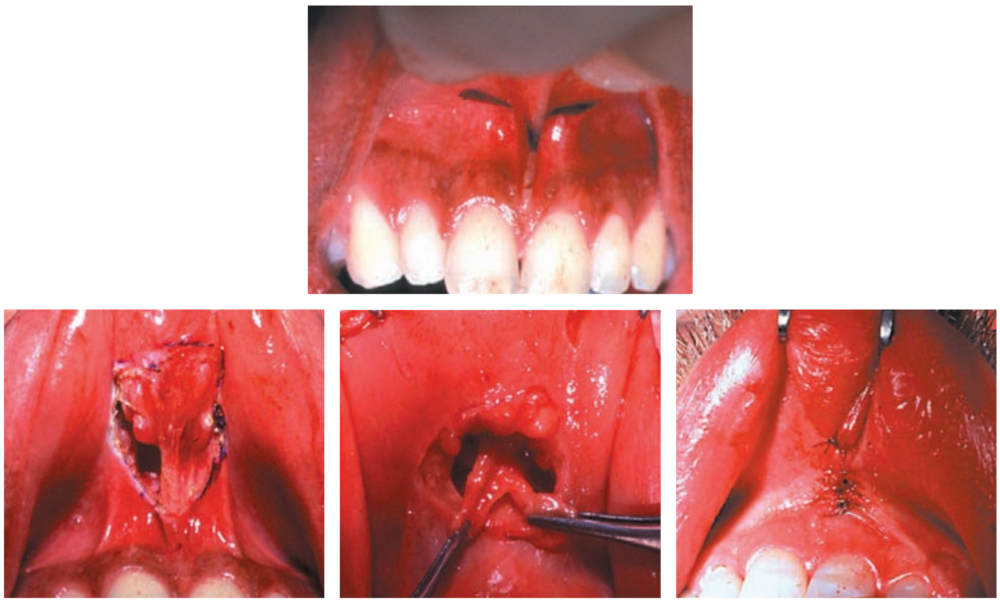
If the patient has alar flaring only and normal nostril size, the flaring is corrected by limiting the excised tissue to the alar flare, leaving at least 1 to 2 mm of the alar base. This prevents alar base notching or blunting of the alar crease. To avoid altering nostril size and/or shape, the incision is not carried into the vestibule. The excised tissue includes the skin and a wedge of deeper tissue including fibrofatty tissue and alar musculature. The wound is closed with 6-0 nylon using the halving principle, because the alar groove incision is longer than the one on the alar surface.

Alar Flaring and Nostril Shape Correction

Excising a complete wedge of alar tissue reduces both alar flaring and the nostril circumference. This is done for nostril asymmetry or excessively large nostrils. The posterior incision is again made at least 1 to 2 mm outside of the alar crease. At the nostril sill, a medially based flap of skin is preserved and this will help to prevent notching of the nostril. The resection extends into the nasal vestibule 2 mm or more above the nostril sill to reduce the internal circumference of the nostril while preventing redundant tissue at the medial end of the incision. The full-thickness lateral rim is resected superiorly as well and includes fibrofatty tissue and alar musculature. The medially based flap is everted during closure with 6-0 nylon using the halving principle to avoid a depressed scar across the nostril sill.

Depressor Septi Nasi Muscle Surgery

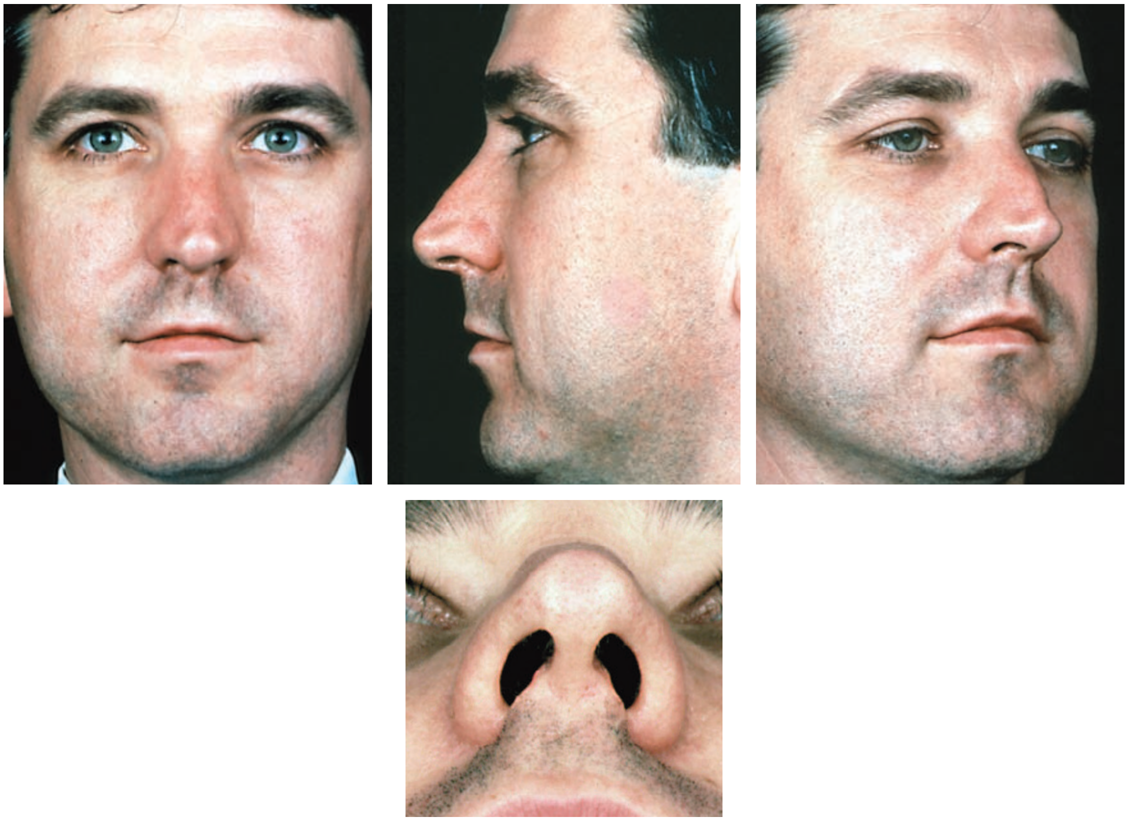
The plunging nasal tip is accentuated by an active depressor septi nasi muscle, diagnosed by a drooping nasal tip and shortened upper lip during animation (smiling). Preoperative diagnosis and operative techniques to address the depressor septi nasi muscle can enhance the lip-tip relationship in rhinoplasty.



During the preoperative rhinoplasty examination, patients are asked to smile so that any dynamic effect of the depressor septi nasi muscle on the nasal tip and upper lip can be assessed. Patients with an active depressor septi nasi muscle, as evidenced by drooping of the nasal tip and shortening of the upper lip when smiling, are candidates for transnasal release of the depressor septi nasi muscle from the medial crura.

If they have tethering of the frenulum, a transoral depressor septi nasi muscle dissection and transposition is performed during rhinoplasty to provide additional lengthening of the upper lip. Transnasal release is typically performed before tip refinement, whereas transoral dissection and transposition can be performed after closure.

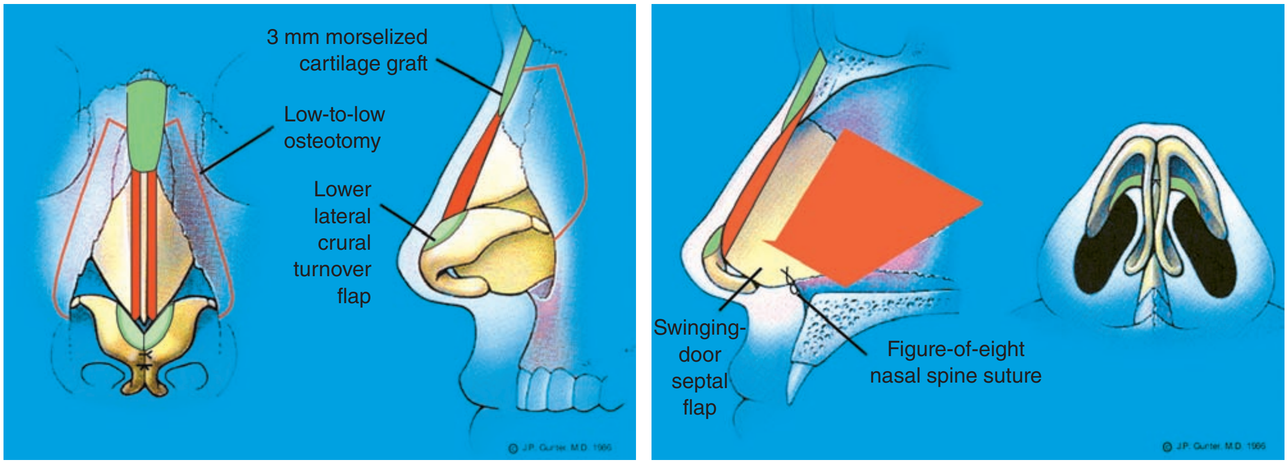
CASE ANALYSES



This 35-year-old man sought primary rhinoplasty because of the following complaints, which are listed in order of their importance to him: (1) nasal airway obstruction, (2) a pinched and asymmetrical nasal tip, and (3) deviation of the nose to the left. Analysis revealed adequate facial proportions on the frontal view. The nose was deviated to the left. In addition, the nasal tip was asymmetrical and had a concave, pinched appearance bilaterally. On the lateral and oblique views, a slight dorsal hump and a low radix were noted. There was adequate tip projection. The tip concavity was confirmed on these views. On the basal view, the nasal deviation was confirmed and a wide alar base revealed. The columellar/lobular ratio was acceptable. The internal nasal examination revealed pink mucosa with a septal deflection to the left without perforation.

The operative goals included the following:

- Correct the nasal airway obstruction.
- Correct tip asymmetry and increase tip projection.
- Correct nasal deviation.
- Correct the low radix.



Surgical Plan

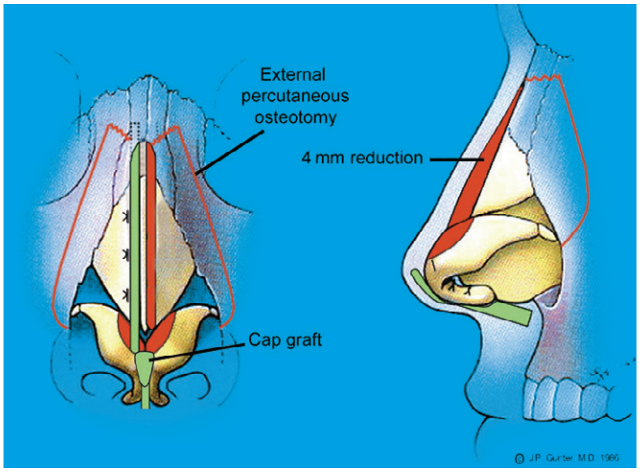
1. Use an open approach with a transcolumellar incision and infracartilaginous extensions.
2. Expose the nasal framework.
3. Expose the nasal septum and harvest septal cartilage.
4. Apply a 3 mm morselized cartilage onlay radix graft to correct the low radix and the appearance of a slight nasal hump.
5. Perform minimal dorsal reduction.
6. Perform low-to-low percutaneous perforated lateral osteotomies to reposition the bony nasal base.
7. Place lower lateral crural turnover flaps to the cephalic portion of the lower lateral cartilages to correct the pinched, asymmetrical appearance of the tip.
8. Place intercrural and interdomal sutures in a graduated approach to increase tip projection.
9. Score the septum and create a swinging-door septal flap with a figure-of-eight suture to the contralateral periosteum of the anterior nasal spine with 5-0 PDS to correct the septal deviation.

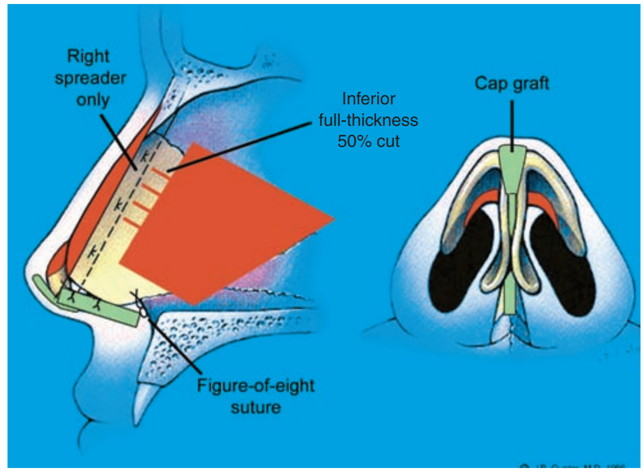
The result is shown 14 years after surgery. Analysis of the preoperative and postoperative frontal views reveals straight dorsal aesthetic lines and a balanced tip and dorsum. The nasal tip is more symmetrical. The lateral preoperative and postoperative views confirm that balance has been established between the tip and the dorsum. Moreover, the low radix has been corrected, resulting in a smooth, straight dorsum. Tip projection is good with a nasolabial angle of approximately 90 degrees. The alar-columellar relationship is normal. The improved nasal balance is confirmed with the oblique views, especially in the area of the midvault. The basal views demonstrate a balanced tip with a 2:1 columellar/lobular ratio. The transcolumellar scar is nearly imperceptible.

This 22-year-old woman requesting primary rhinoplasty presented with a dorsal septal reverse-C-shaped deviation, a bulbous tip, a dorsal hump, and a short upper lip. The frontal view revealed Fitzpatrick type III thick skin, with a reverse-C-shaped deviated nose. Her facial proportions were good. The nasal tip deviated to the left, and there was a wide nasal base. She had a bulbous tip with slight alar flaring (left greater than the right). The lateral view showed a normal radix with a 4 mm dorsal hump. Tip projection and nasal length were normal. She also had a short upper lip. The intranasal examination revealed nasal airway obstruction (more on the left than the right) with obstructive anteroinferior septal deviation and inferior turbinate hypertrophy on the right side. The oblique view confirmed the dorsal hump and nasal bulbous tip. The basal view revealed a left caudal septal deviation, a bulbous tip, and slight alar flaring.

The operative goals included the following:

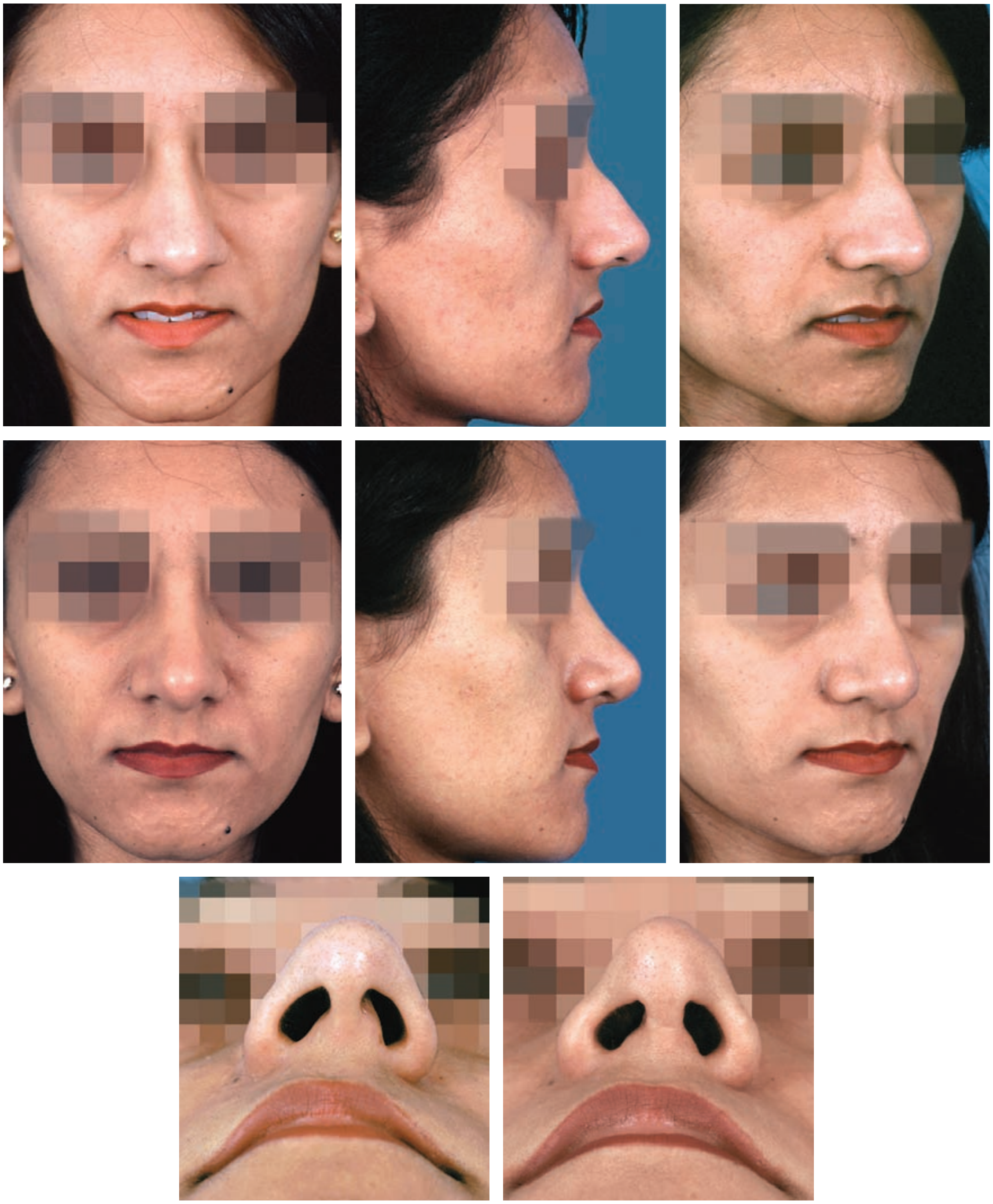
- Correct the nasal airway obstruction.
- Correct the dorsally deviated nose.
- Correct the bulbous tip and refine the tip.
- Narrow the nasal base.
- Correct the short upper lip.





Surgical Plan

1. Use the open approach with a transcolumellar incision and infracartilaginous extensions.
2. Expose the dorsal framework.
3. Separate the upper lateral cartilage from the septum proper.
4. Perform component dorsal hump reduction (comprising a 4 mm cartilage and bony reduction).
5. Perform septal reconstruction and harvest the remaining 10 mm caudal and dorsal strut.
6. Straighten the dorsum with 50% full-thickness inferior cuts from the deviated L-strut segment inferiorly.
7. Create and place a right spreader graft to keep the L-strut straight and strengthen the septal dorsal aesthetic lines.
8. Use a figure-of-eight suture in the caudal septum to correct the caudal septal deviation.
9. Perform cephalic trim, retaining a 5 mm alar rim strip.
10. Secure the columellar strut graft with 5-0 PDS medial crural–columellar strut sutures.
11. Refine the tip with interdomal and transdomal sutures and place a cap graft from the cephalic trim.
12. Place low-to-low percutaneous perforated lateral osteotomies to close open roof.
13. Perform transoral dissection and transposition of the depressor septi nasi muscle.



The patient is shown 2 years postoperatively with a straight nose, improved dorsal aesthetic lines, and a refined nasal tip. The lateral view shows a smooth, straight dorsum with a slight supratip break and improved nasal length, along with a normal radix and tip projection. She has a 95-degree nasolabial angle and an improved alar-columellar relationship. In addition, the subtle increase in upper lip length that has been achieved by the depressor septi nasi muscle release has enhanced the tip-lip relationship. The oblique view demonstrates the improved nasal dorsal-tip balance. The basal view also shows the improved alar-columellar relationship, straight columella, and aesthetic triangular nasal tip.

CONCLUSION

Over the past 25 years, several key concepts and strategies for success have emerged and play a critical role in achieving consistently good aesthetic and functional results after rhinoplasty. Accurate preoperative assessment and proper execution of rhinoplasty based on the anatomic deformity and using a graduated surgical approach is critical. The open approach provides great exposure and opportunity to more accurately assess and manipulate the structural elements of the nose. In our experience, the results of certain techniques are maintained over the long term, whereas others do not hold up well over time. By critically examining our long-term results, we have found that the early results using visible grafts had the potential to develop late deformities because of changes in the grafts themselves or their displacement.

In addition, techniques that preserve cartilage when possible and/or provide additional structural support such as columellar strut grafts and alar contour grafts improve longevity of the result after rhinoplasty. Our approach has evolved to apply the information gathered from these observations to provide increased consistency and longer durability in results after primary rhinoplasty. Finally, it is critical to follow patients for the long term. Expertise and experience are gleaned from critical analysis of one's own results.

KEY POINTS

- Systematic nasal analysis allows comprehensive nasal analysis to identify nasofacial disproportions and imbalances and will help to establish the goals for rhinoplasty surgery.
- If the patient is unhappy with the imaging projections or requests something that is not possible or not aesthetically pleasing or proportional, do not operate!

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Toriumi's Approach

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Rhinoplasty is a complex operation that requires careful preoperative assessment and planning, as well as meticulous and sound surgical techniques. Surgeons without the patience to take the time to perform rhinoplasty in such a manner will likely find their results suboptimal if they follow their patients over time. There is no universal rhinoplasty technique that can be used successfully in every rhinoplasty. Instead, a structure approach can be applied, using a variety of techniques that are chosen based on anatomy and desired outcome.

Rhinoplasty is a complex operation that requires careful preoperative planning and assessment, meticulous execution of the procedure, and an understanding of the natural forces from scar contracture that can lead to less than ideal results.

The structure approach to rhinoplasty emphasizes support in the areas of the nose where there is a predisposition for weakness and subsequent irregularities and/or nasal airway compromise over time. Many patients' noses change significantly over time, with narrowing and possibly collapse simply because of the aging process and without the trauma of surgery. These changes are much more prominent in patients with thin skin and projecting noses. The operated nose is frequently weakened and will tend to contract and change over the patient's lifetime. Typical changes are supraalar pinching, narrowing of the middle vault, weakening of the lateral sidewalls, and loss of tip projection and rotation. With scar contracture, breathing difficulties and/or cosmetic defects may become more apparent. By stabilizing the structure of the nose during rhinoplasty, the negative impact of scar contracture over time is reduced. By adding support where there is weakness, these typical changes can be minimized. This structure approach to rhinoplasty is applied to both primary and secondary cases.

The structure approach to rhinoplasty refers to the use of structural grafting techniques that support the nose in areas that are predisposed to weakness or collapse postoperatively. Autologous cartilage is used as grafting material for rhinoplasty. The three main sources of cartilage are from the septum, auricle, and rib. Costal cartilage is frequently used in reconstructive and secondary rhinoplasty to provide maximal structural support and long lasting outcomes.

BACKGROUND

The approach to rhinoplasty has evolved over the past two decades from a reductive approach to an emphasis on structural grafting.[1,2] With long-term follow-up, some patients who underwent reductive rhinoplasty were noted to have problems such as a pinched tip, middle vault collapse, lateral wall weakness, and nasal obstruction. Based on this observation, the senior author moved away from reductive techniques, adopting instead a structure approach to this difficult operation. The structure approach uses multiple cartilage grafts to stabilize areas of the nose that are susceptible to collapse or deformity over time. Techniques also have been modified to emphasize a natural appearing nasal tip with curvilinear contours and good projection. We have moved to the use of more costal cartilage because of its strength and abundance. Moreover, there is a more intense focus on long-term preservation of nasal function.

In this era of surgical innovations, surgeons may consider using alloplastic materials for augmentation in rhinoplasty. Materials such as silicone, Medpore, and Gore-Tex are used for augmentation in rhinoplasty. Although these materials are suitable for applications in other areas of plastic surgery, the risks associated with use of alloplastic implants in rhinoplasty tend to outweigh the benefits. Many patients who have undergone rhinoplasty with such implants are happy with the cosmetic results and have no complications. However, there is a subset of such patients who have had significant complications. Alloplastic implants in rhinoplasty have been associated with infection, skin damage and atrophy, implant extrusion, localized pain or discomfort, and unsightly aesthetic results. With the abundance of autologous grafting material, even the most difficult secondary rhinoplasty procedure can be successfully accomplished without the use of an alloplastic implant. We routinely use cartilage from the septum, auricle, and/or rib for grafting in rhinoplasty.

INDICATIONS AND CONTRAINDICATIONS

Primary rhinoplasty is indicated in patients who have nasal deformities and desire correction. This also holds true for most individuals who request secondary rhinoplasty. For all patients who present for rhinoplasty, the patient and the surgeon must strive for a similar aesthetic goal. This can be determined during the initial consultation, when the surgeon and patient have the opportunity to discuss proposed changes and concerns (both functional and cosmetic).

Computer imaging can assist the surgeon in discussing the proposed changes with the patient. The surgeon is cautioned against showing changes that are unrealistic or beyond his or her capabilities.

There are several contraindications to rhinoplasty. Patients who are mentally or emotionally unstable are often not suitable candidates for rhinoplasty. The surgeon must determine whether a patient will be able to tolerate the stress of the operation and postoperative changes. If he or she believes that the patient's emotional stability requires further elucidation, the patient may be asked for permission to contact the patient's psychologist or psychiatrist.

Current surgical techniques have enabled successful improvement in many severely deformed noses that previously would have been inoperable. Costal cartilage grafting can be used to correct severely foreshortened and overrotated noses. However, we continue to be limited by the conformability of the skin–soft tissue envelope. The nose can be changed only within its skin–soft tissue envelope, which sometimes results in less than ideal results.

There are also patients in whom the skin–soft tissue envelope is severely damaged, often the result of prior rhinoplasty (for example, implant extrusion and thinning of the skin). Indicators of skin–soft tissue envelope damage include color changes, atrophy or thinning of the skin, skin necrosis, and telangiectasias. In some of these patients the damage is so severe that further rhinoplasty is not recommended. In others, however, removal of the instigating factor (for example, an alloplastic implant) or simply waiting for the skin to heal will provide enough improvement in the skin–soft tissue envelope condition that the surgeon can proceed in planning the operation.

PREOPERATIVE ASSESSMENT AND PLANNING

Accurate and complete preoperative assessment and planning for any rhinoplasty is critical for any surgeon interested in achieving good results. During the initial consultation the surgeon has the opportunity to understand the patient's goals, to evaluate the nasal structure and airway, and to demonstrate proposed changes using computer imaging. With careful preoperative assessment, the surgeon is better able to explain the procedure and potential complications to the patient.

Computer imaging is a useful tool that allows the surgeon to demonstrate proposed changes for the patient. The altered images provide several benefits for both the surgeon and the patient. First, the surgeon can ascertain whether the patient's goals for surgery are realistic. For example, a patient with an overprojected nose, low dorsum, and thick skin will not be a good candidate for purely reductive rhinoplasty. Instead, the nose may need to be made larger in some dimensions by augmenting the dorsum to account for the excess skin that will not redrape easily because of its thickness. This sort of change may be difficult for most patients to understand. Demonstrating these changes with computer imaging allows the patient to better visualize the results that are possible with the proposed surgery. Second, computer imaging allows the patient to have both a verbal and visual explanation of the proposed surgery. The surgeon should avoid providing computer-enhanced proposed outcomes that are not readily attainable because of the surgeon's experience, or limitations set by a patient's specific nasal defect, such as a tightly scarred skin–soft tissue envelope. Presenting realistic outcomes or underimaging the outcomes will always benefit the surgeon, and this method will help to avoid patient dissatisfaction.

OPERATIVE TECHNIQUE

Success in rhinoplasty requires the surgeon to have a complete armamentarium of techniques that can be used based on the anatomy and projected goals. Detailed below is the surgical technique for accessing the nose through an open approach, stabilizing the nasal base, setting the nasal tip, and augmenting the nasal dorsum.

The patient is prepared and draped with the entire face exposed throughout the procedure. The patient's preoperative photographs and imaging are displayed for reference during surgery. These images are frequently viewed, because they represent the goals of the surgery. This is one reason why the imaging must be an accurate assessment of what could be a realistic outcome.

The nose is injected with 1% lidocaine with 1:100,000 epinephrine into the nasal tip, columella, septum, between and around the domes, along the lateral nasal wall, and at the site of the marginal incisions. If lateral osteotomies are planned, the local anesthetic is injected along these sites as well. The nose is packed with pledgets lightly soaked with a vasoconstrictive agent, and at least 10 minutes is allowed before the incision to permit the vasoconstriction to take effect.

An inverted-V transcolumellar incision is marked approximately halfway between the domes and the base of the nose. It is better to err lower along the columella, if necessary, to reduce the risk of scar visibility. If the patient has a previous columellar scar, the incision is made through the previous scar when possible. If excision of the previous columellar scar is contemplated, the initial incision should be made just above the previous scar. At the end of the operation if there is adequate skin to allow scar excision this can be executed at the time of final closure. A sawing motion is made with a No. 11 blade to remain precisely within the markings. Special care is taken to avoid damaging the underlying medial crura. The infracartilaginous incision is then made using a No. 15 blade at the caudal margin of the lateral crura. It is then connected to the transcolumellar incision using Converse scissors. The columellar flap is then carefully elevated so as not to damage the middle or medial crura. Three point countertraction is used during elevation to facilitate dissection.[3] The middle vault is exposed, and a subperiosteal pocket is made over the bony dorsum using a Joseph elevator. If a radix graft is planned, a narrow subperiosteal pocket is created in the radix to minimize the chances that a graft placed into this pocket at the end of the operation will move postoperatively.

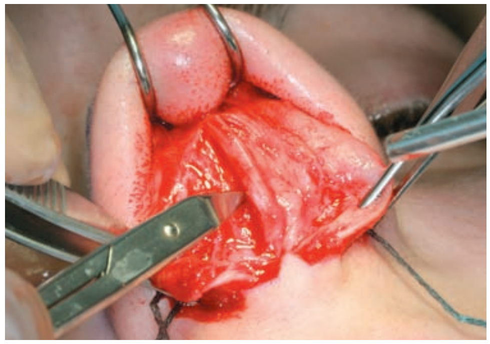
In secondary rhinoplasty, extreme care must be taken when exposing the nose. The incisions and approach are the same as described for a primary rhinoplasty; however, the surgeon must keep several possible obstacles in mind. The tissue planes may be disrupted, and scarring is frequently encountered. The lower and upper lateral cartilages may have been previously excised or moved. Grafts or implants may be found in different planes and could make removal difficult. We prefer to remove all alloplastic materials before nasal reconstruction. When an alloplastic dorsal graft is removed, the surgeon may encounter a larger than ideal dorsal pocket into which to place a graft. Cartilaginous grafts are also frequently removed. At times, palpable or visible irregularities are present, which are the result of grafts placed against the subcutaneous soft tissue. Removal of such grafts must be done carefully so as not to damage the skin.

If the septum needs to be accessed to correct nasal airway obstruction resulting from deviation and/or to harvest cartilage for grafting, this is usually performed next. If bony nasal work is planned, then this should be performed first, with the septum intact, for additional structural support. The septum is approached by dissecting between the medial crura to expose the caudal septum. Once the caudal septum is identified, sharp dissection is performed to identify the subperichondrial plane, taking care to dissect all mucoperichondrium off of the septal cartilage before removal. Leaving perichondrium on the cartilage can significantly thin and weaken the septal flaps. Once exposed, septal cartilage is harvested, leaving at least a 15 mm caudal and dorsal strut. Up to 20 mm of dorsal strut is left at the osteocartilaginous junction to provide additional support and prevent postoperative saddling. If the rhinoplasty is approached using a closed technique, then a Killian incision is used to gain access to the septum. This will reduce the amount of disruption between the caudal septum and medial crura,[4] which could lead to decreased tip support postoperatively.

Nasal Base Stabilization

The next step involves stabilizing the nasal base in patients with an acute nasolabial angle, a poor alar-columellar relationship, a dependent or underprojected tip, and/or a retracted columella. Nasal base stabilization can be achieved by using one of several techniques. The method chosen is dependent on the specific nasal base deficit or deformity and surgical goals. The possible approaches include (1) setting the medial crura back onto the caudal septum, (2) a columellar strut graft, (3) a caudal septal extension graft, and (4) an extended columellar strut graft. The grafts are crafted from septal or costal cartilage, because these sources provide excellent structural support. Auricular cartilage is not preferred but can be used if two layers are doubled up, opposing the curvatures to avoid deformity. After the grafts are placed, the surgeon must confirm that the domes are set symmetrically and other parameters, such as the alar-columellar relationship, the position of the nasolabial angle, and the length of the upper lip, are appropriate.

The nasal base is stabilized by means of one of several techniques. These include (1) medial crura fixation onto an overlong midline caudal septum, (2) a columellar strut graft, (3) a caudal septal extension graft, and (4) an extended columellar strut graft. Costal cartilage is frequently used for caudal extension grafts and extended columellar struts. The decision to employ one technique over the others depends on the specific anatomy and goals for each case.



In patients with a hanging columella or a tension tip, the caudal septum tends to be too long. In such cases the medial crura can be set back onto the overlong caudal septum after dissecting between the medial crura and raising bilateral mucoperichondrial flaps off of the septum.

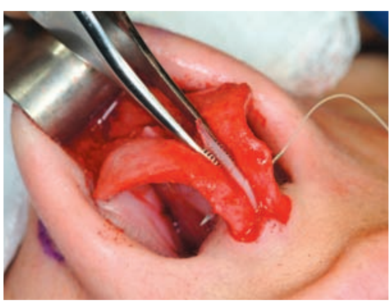
In a patient with an overprojected nose that is the result of an oversized tension-type septum, the medial crura can be dissected apart and deprojected closer to the face.

A transfixing suture is used to set back the medial crura on the overlong caudal septum. With the medial crura sutured into position, an additional fixation suture of 5-0 PDS is placed on the internal surface of the medial crura. It is critical to be certain that the caudal septum is midline; otherwise, the columella will be deviated as well. This maneuver is stabilized by means of a 5-0 plain catgut suture on a straight septal needle using a tongue-and-groove technique.[3] If the nasolabial angle, tip projection, and alar-columellar relationship are satisfactory, the base is further stabilized with a 5-0 PDS suture passed through the medial surface of the medial or middle crura. This technique is preferred over simply trimming the caudal septum, because the surgeon will be better able to predict the final tip position postoperatively by using the excess caudal septum as a stable fixation point.

A columellar strut graft is used in cases where the alar-columellar relationship is appropriate and the tip is already well supported. Most well supported noses will have long, strong medial crura with footplates that extend down to the nasal base, whereas poorly supported noses will frequently have short medial crura with footplates that fall short of the nasal base.

The patient on the left has long medial crura that extend down to the nasal base. This patient has good nasal base support. The patient on the right has short medial crura. This patient will require additional nasal tip support to prevent postoperative loss of tip projection.

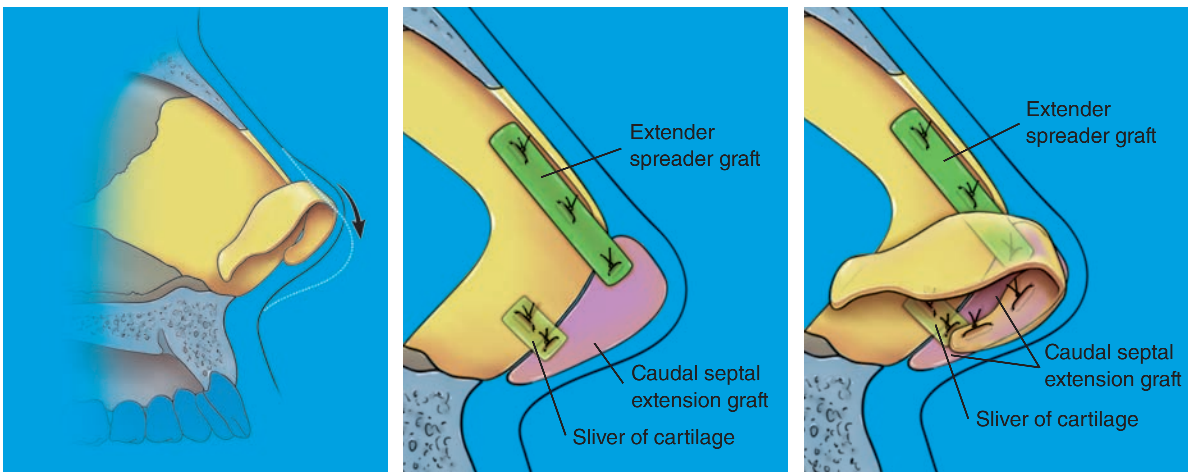
The columellar strut graft improves tip support with little effect on tip projection. The columellar strut graft may slightly increase tip projection in cases where the middle or medial crura are buckled before the crura are sutured to the graft. In some cases a long, strong columellar strut graft can effectively increase nasal tip projection.

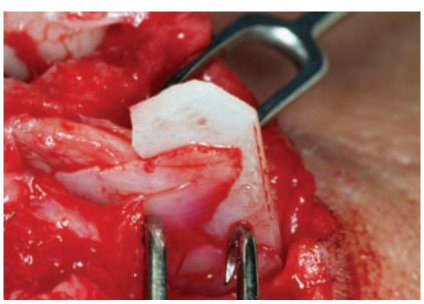


The columellar strut graft is placed into a pocket and sutured between the medial crura. The fixation suture is placed closer to the posterior margin of the medial crura to maintain the natural divergence of the caudal margin of the middle crura.

The columellar strut graft is rectangular. It is placed between the medial crura, keeping a bed of soft tissue between it and the anterior nasal spine. If the columellar strut graft is placed too close to the anterior nasal spine without fixation, the patient may experience a clicking sensation when smiling. The graft is fixed to the medial crura using a 5-0 plain catgut suture on a straight septal needle and then further stabilized with a 5-0 clear nylon suture, as described earlier.

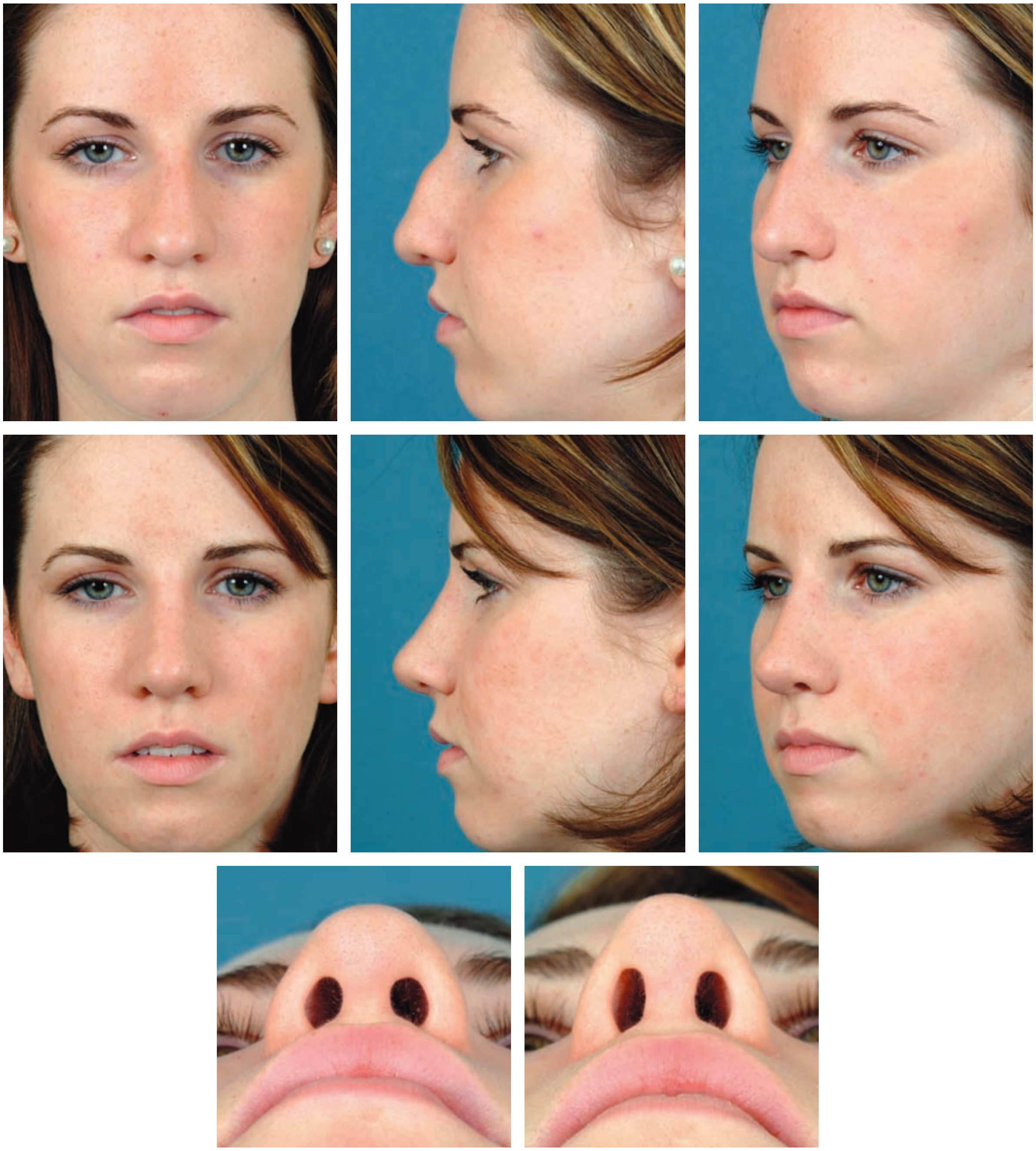
The caudal septal extension graft is a versatile graft that is used in patients who have a foreshortened nose or retracted columella. The caudal septal extension graft is aligned end to end with the existing caudal septum and stabilized with splinting grafts, such as extended spreader grafts or thinner wafers of cartilage sutured bilaterally.[3] The caudal septum must be positioned in the midline prior to placing the end to end caudal septal extension graft. The medial crura are positioned on the caudal margin of the extension graft to achieve the desired tip rotation and projection. The placement is set using a 5-0 plain catgut suture on a straight septal needle, followed by a more permanent fixation using a 5-0 PDS suture that is passed between the medial aspect of the domes/medial crura and the caudal septal extension graft. The surgeon should ensure that the nasal tip is in the midline after placing the caudal extension graft to avoid postoperative asymmetry.





Caudal septal extension grafts can be modified in shape to create different effects on the position of the nasal tip.[5] Extended spreader grafts or slivers of cartilage are used to stabilize the caudal septal extension graft set end to end. In most cases the caudal septal extension grafts are triangular in shape and oriented so the superior margin is longer.

This shape will prevent rotation of the nasal tip and can counterrotate the nasal tip if the superior margin is extended. To treat an acute nasolabial angle, the caudal septal extension graft is triangular shaped with the longer margin oriented inferiorly. Care must be taken when the caudal septal extension graft is extended inferiorly to push out the nasolabial angle. This type of graft can alter the position of the upper lip and also can alter the patient's smile. Patients may develop a crease in their upper lip when they smile.

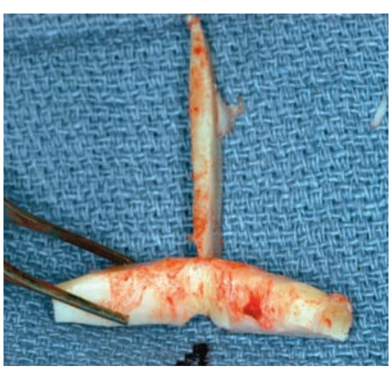


This patient has an acute nasolabial angle and slightly ptotic nasal tip. She had a deficiency of support in the nasal base. A caudal extension graft with a longer inferior margin was used to correct the acute nasolabial angle and rotate the tip. She is shown 1 year postoperatively. As shown above, to correct an acute nasolabial angle, shaping the graft so that it is longer at the inferior aspect will help to blunt this angle. The caudal extension graft can be used to rotate/counterrotate and/or project/deproject the nasal tip depending on the needs of the patient.

In patients with severely deficient tip support, a retracted columella, ptotic tip, excessive scar tissue, deficient premaxilla, and/or heavy thick skin, an extended columellar strut graft is recommended. Examples of such patients include those with congenital deficiencies (for example, Binder's syndrome or cleft lip–nasal deformity) and patients who have undergone previous rhinoplasty in which excessive resection of the caudal septum was performed, resulting in loss of projection and ptosis of the tip. Costal cartilage is used to provide sufficient strength and support to permanently correct such problems.

The costal cartilage extended columellar strut graft can be used to increase tip projection in a patient with severe deficiency in the tip position. The graft is positioned from the anterior nasal spine to the desired final position of the domes. Before the graft is set in place, the soft tissue between the medial crura must be dissected down to the anterior nasal spine, which will also allow the medial crura to be advanced on the graft, as detailed in the following paragraphs.

The extended columellar strut is usually fixed to the anterior nasal spine in some fashion. A 5 mm straight osteotome can be used to make a notch in the caudal aspect of the anterior nasal spine. This may require trimming a portion of the caudal septum to make room for the extended columellar strut. Once the notch is created the extended columellar strut can be placed into the notch and sutured into place. Two 4-0 PDS sutures can be used to grasp soft tissue around the anterior nasal spine and then passed through the extended spreader graft. If no soft tissue is able to support the suture, a 16-gauge needle can be used to drill a hole through the anterior nasal spine then the suture can be passed through the hole and through the graft. A notch can be made in the extended columellar strut along its posterior margin to allow it to fix into the notch in the anterior nasal spine.

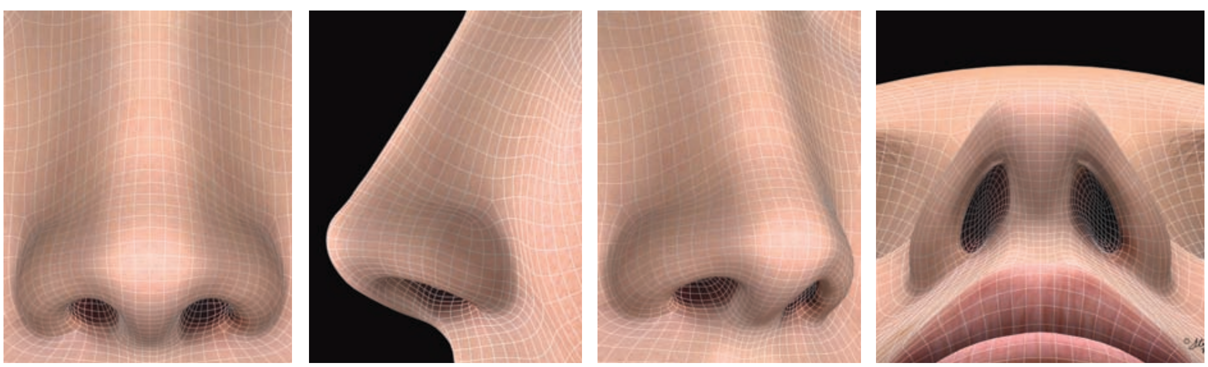


In patients with premaxillary deficiency, the extended columellar strut graft can be combined with a premaxillary graft. In this case, the strut graft will sit on the superior aspect of the premaxillary graft in a midline notch and be sutured in place. The premaxillary graft is positioned over the anterior nasal spine.

With the extended columellar strut graft fixed to the anterior nasal spine, the medial crura are advanced anteriorly onto the graft and sutured using 4-0 plain catgut on a straight septal needle. This maneuver will increase tip projection and can help to open the nasolabial angle.[3] If additional advancement is needed, the footplates of the medial crura can be released.[4] If the tip position is favorable, then two 5-0 PDS sutures are placed between the inner surface of the medial and middle crura to the graft to further stabilize the graft into position.

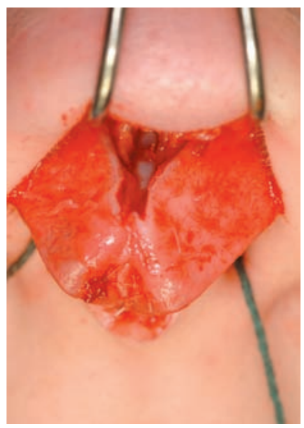
Nasal Tip Lobule

Once the nasal base is stabilized, refinement of the tip can be performed. Aesthetically, the double break seen on profile and shadowing behind the tip on frontal view are preferred over a pinched, narrow tip.[6] The primary objective in nasal tip surgery is to eliminate unfavorable shadows and create favorable shadows. There should be a continuous ridge that extends from the tip-defining point to the alar lobule with a subtle supratip shadow that continues into the supraalar groove. The domes should take on a horizontal orientation, avoiding shadows lateral to the domes, which act to isolate the tip and create a pinched appearance on frontal view. The methods that can be employed to achieve the desired tip contour and shadowing include both suturing techniques and grafting.



Favorable nasal tip contour demonstrates shadowing in the proper locations. On frontal view, there is a subtle shadow in the supratip region that extends laterally into the supraalar grooves. The nasal tip has a horizontal tip orientation with a ridge that extends laterally into the alar lobule. A subtle supratip break with a relatively straight dorsum defines the profile view. The base view demonstrates a triangular nasal base with an uninterrupted transition from the tip to the alar lobule.[6]

The dome-binding suture is a commonly used method for narrowing the domes and setting the tip width/interdomal distance. A 5-0 PDS mattress suture is placed through each dome tying the knots between the domes. It should gently flatten the dome to create narrowing in the tip. Care should be taken, however, to avoid excessive pinching or narrowing of the interdomal distance, which creates an unnatural, operated appearance. The normal interdomal distance should be slightly wider than the width of the middle vault.[4]

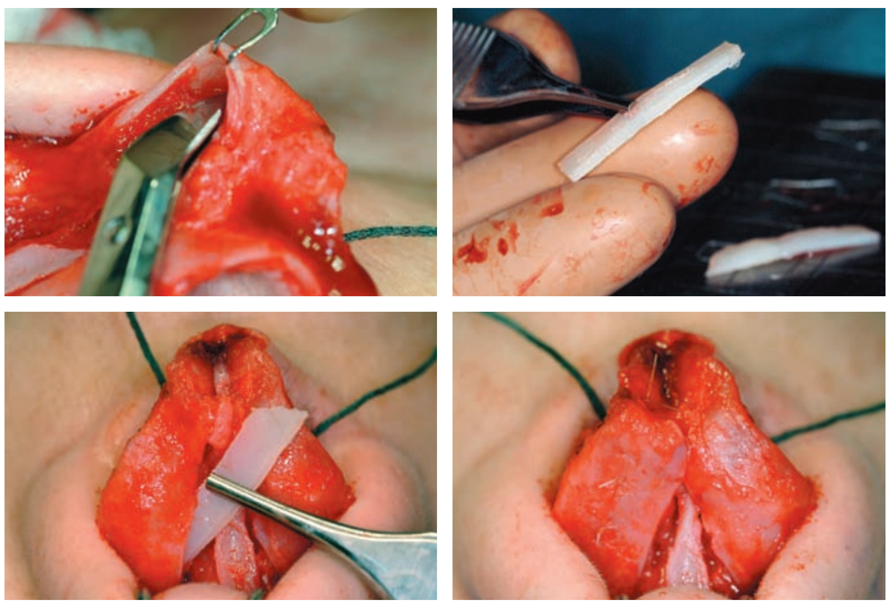


Bilateral dome-binding sutures are placed. Note the symmetrical narrowing of the domes with little pinching or deformity.

The exact placement of the dome-binding suture can be varied to achieve different goals. For example, if the dome-binding suture is placed lateral to the domes, this will cause the tip lobule to rotate slightly and project by pulling the lateral crura medially.[4] On the other hand, if counterrotation and deprojection are desired, the suture is placed medial to the domes. This will create the illusion of increased length by blunting the columellar-lobular angle. When the suture is placed at the domes, there will be a slight increase in projection and rotation.

In some patients with bulbous nasal tip cartilage, placement of dome-binding sutures may not achieve the desired changes. Instead of flattening the lateral crura and producing tip definition, this technique may result in internal recurvature of the lateral crura, with resultant nasal airway obstruction and/or deformed lateral crura/domes. When this occurs, a lateral crural strut graft may be used.

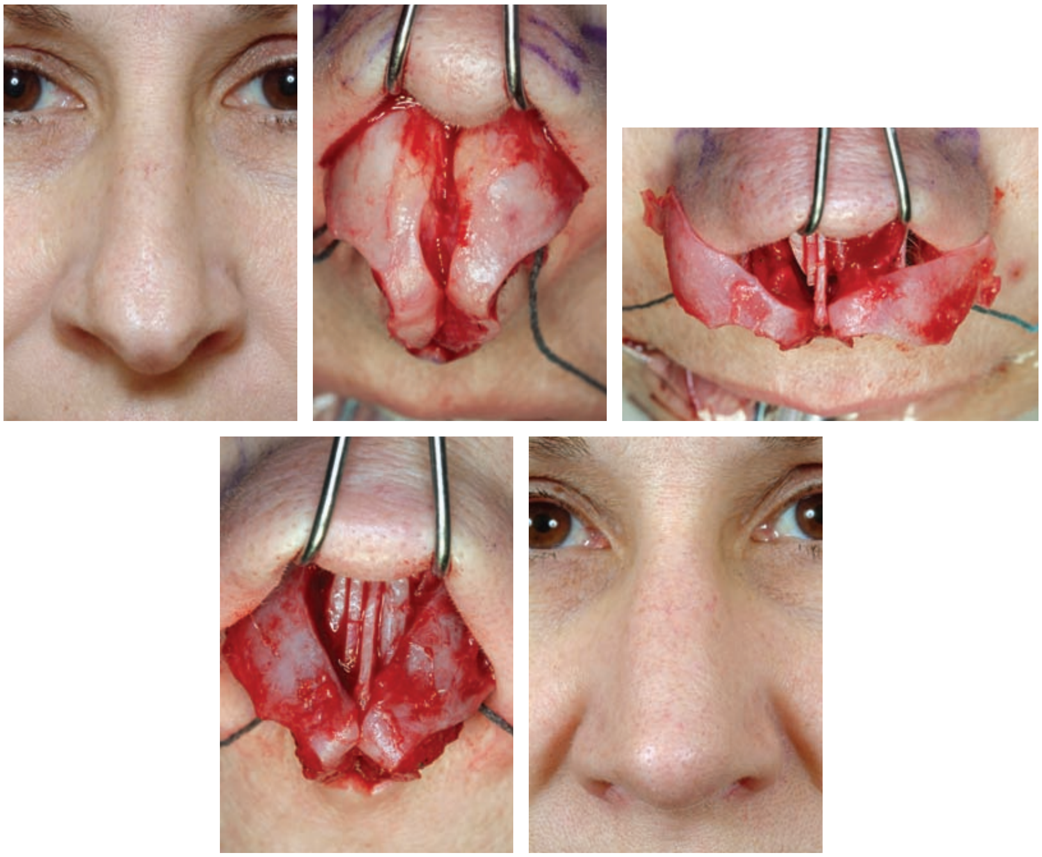
The lateral crural strut graft is a rectangular piece of cartilage that is placed on the undersurface of the lateral crura (between the cartilage and the vestibular skin). This graft can be used to flatten bulbous lateral crura and to correct internal recurvature of the cartilage. Before making a pocket for the graft, local anesthetic is injected into the vestibular skin, which will help to hydrodissect the skin off of the undersurface of the lateral crura.



Placement of a lateral crural strut graft begins with dissection of the vestibular skin off of the undersurface of the lateral crus. The septal cartilage graft is carved. The graft is then placed between the vestibular skin and the undersurface of the lateral crus. Two 5-0 PDS sutures are used to affix the graft to the undersurface of the lateral crus. Note how the lateral crura are now flattened, eliminating the bulbous shape.

With the lateral crural strut graft in place, dome-binding sutures may then be used to create the desired tip contour. By placing two separate dome sutures the narrowing of the nasal tip can be precisely controlled. Over pinching of the domes should be avoided to prevent deformity.

Once the dome-binding sutures are placed, the interdomal distance and nasal tip width are set. A 5-0 PDS suture is placed between the medial surfaces of the middle crura and the domes. The domes should not be tightly pulled together because this could result in blunting of the double break or the columellar-lobular angle.[4] The interdomal suture does not need to be placed if a tip graft is planned.



In some patients the lateral crura are oriented cephalically and run adjacent to the middle nasal vault. This orientation of the lateral crura disrupts the favorable shadowing of the supratip area and also creates shadowing along the junction with the alar lobule, creating the parenthesis deformity. One option for correction is to reposition the lateral crura by dissecting the lateral crura from the underlying vestibular skin. Lateral crural strut grafts are sutured to the undersurface of the dissected lateral crura and then placed into caudally positioned pockets. Placement of the pockets is critical and must be symmetrically positioned to insure symmetric nostril margins. Repositioning the lateral crura will change the angle of the lateral crura off of midline from a less favorable angle (less than 32 degrees) to a more favorable angle off of midline (greater than 32 degrees). Dome sutures can be placed into the domes to create proper tip contour. By repositioning the lateral crura the shadows of the nasal tip are altered to show favorable shadowing. Repositioning of the lateral crura also moves cartilaginous

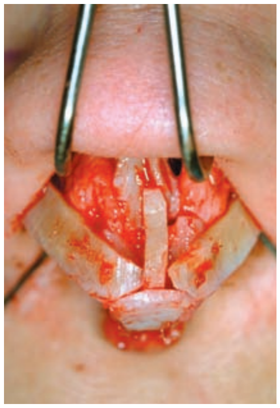
support to the lateral wall of the nose to improve nasal function. Repositioning the lateral crura also provides tremendous control of alar positioning and increases lateral wall support.

A tip graft can be used when additional tip refinement and/or projection are desired. A shield-shaped tip graft typically is carved from softer cartilage (septal or auricular). The shield graft should be soft enough to provide slight cephalic rotation (corresponding to the double break) but strong enough to resist excessive cephalic rotation. The shield graft is fashioned so that the anterior leading edge is thicker and wider than the inferior edge, which should be very thin. The edges of the graft are beveled to reduce the risk of visibility. The shield-shaped tip graft is affixed to the existing domes and medial crura using at least four 6-0 Monocryl sutures.

The nasal lobule is altered to achieve a natural-appearing contour with favorable shadowing and a horizontal tip orientation. There should be a continuous ridge that extends from the tip-defining point to the alar lobule with a subtle supratip shadow that continues into the supraalar groove. One should avoid pinching of the nasal tip with a sharp demarcation between the tip lobule and the alar lobule. There are several methods and grafts that can be used to refine the nasal lobule. These include dome-binding sutures, lateral crural strut grafts, tip grafts, and alar rim grafts.

One of the main concerns in using a tip graft is visibility postoperatively. In many patients the tip graft can become visible many years after surgery when the tip skin contracts over the graft. Camouflage is therefore an important consideration every time a tip graft is used. A buttress graft can be placed behind the leading edge of the tip graft and sutured to the posterior surface of the tip graft. Not only does the buttress graft help to camouflage the graft by producing a transition between the tip graft and surrounding structures, but it also helps to prevent excessive cephalic rotation of the tip graft by supporting the posterior surface of the tip graft.

This patient has thicker skin and a wide nasal tip. After her nasal base was stabilized with a caudal extension graft, a shield-shaped tip graft was used to gain additional tip definition. The tip graft was supported and camouflaged with a buttress graft. She is shown 3 years postoperatively.

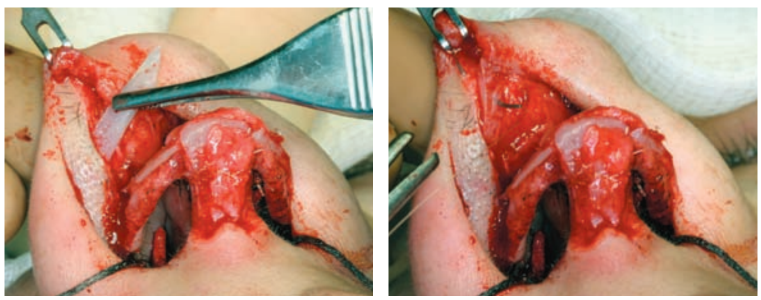


In cases in which the tip graft projects more than 3 mm above the existing domes, further camouflage and stabilization are necessary. Lateral crural grafts are rectangular grafts that are placed on top of the lateral crura at approximately 45 degrees off of the lateral leading edge of the tip graft. The lateral crural graft is sutured to the lateral and posterior surface of the tip graft and also to the existing lateral crura. Symmetry along the caudal margin of these grafts is critical to preserve the symmetry of the nostrils. This graft also provides support to the tip graft, prevents excessive cephalic rotation of the tip graft, and helps to create the natural appearing triangularity of the nasal base.

Camouflage of the tip graft is also accomplished by covering the leading edge of the graft with crushed cartilage and/or perichondrium. The cartilage taken as the cephalic trim can be used to camouflage tip grafts and should be placed just behind the leading edge of the tip graft, extending beyond the lateral margins of the tip graft and can be sutured with 6-0 Monocryl sutures. The thicker costal cartilage perichondrium is also ideal for camouflaging tip grafts, as shown above, because it is thicker and stronger than auricular perichondrium. The perichondrium will create some early tip edema, which will improve within 3 to 6 months after surgery. If a tip graft is visible at the time of surgery, it is likely to become a problem over time. It should be emphasized that irrespective of the camouflage planned, a tip graft should be avoided in patients with thin skin because of the high risk of graft visibility.

A shield-shaped tip graft can increase tip definition and projection. Whenever a tip graft is used, methods to camouflage the graft must also be employed. These include the use of grafts (buttress and lateral crural grafts) as well as covering the leading edge with perichondrium and/or crushed cartilage. Tip grafts should be avoided in patients with thin skin because of the high risk of graft visibility.

Alar contour grafts are frequently employed to create the desired tip contour.[6] Not only does the alar contour graft correct alar rim weakness but it also helps to create the desirable triangular shape of the nasal base, with resultant shadowing behind the nasal lobule. The graft creates a natural appearing nasal tip that is not pinched or narrow, but has its shadows cast in the proper places to provide an elegant look.[8]

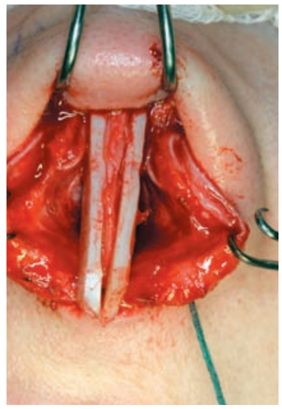


The alar contour graft is composed of thin strips of soft cartilage and is placed in a pocket along the caudal edge of the infracartilaginous incision. The graft is fixed medially to the subcutaneous tissue using a 6-0 Monocryl suture. The medial edge of the alar contour graft is then gently crushed with Adson forceps to soften the edge and avoid visibility in the region of the domes.

Middle Vault

The middle vault is made up of the upper lateral cartilages and the dorsal nasal septum. When dorsal hump reduction is performed, the upper lateral cartilages are at risk for inferomedial collapse because of loss of the horizontal component of the roof of the middle vault. Such collapse is particularly prominent in patients with short nasal bones and long upper lateral cartilages because of the lack of support.[2] One of the long-term adverse results frequently seen after rhinoplasty is a pinched middle vault. When this occurs, internal nasal valve narrowing or collapse can result in significant nasal obstruction. With these potential problems in mind, middle vault support using spreader grafts is recommended.

During the preoperative consultation, both preexisting middle vault pinching and dynamic lateral wall collapse are observed and noted. When they are seen, the surgeon should plan on augmenting the middle vault during surgery. Moreover, any time that the middle vault is opened during rhinoplasty, it is reconstructed with bilateral spreader grafts to prevent late middle vault collapse.



Spreader grafts are long, rectangular pieces of cartilage that are positioned on one or both sides of the dorsal septum in the middle vault region to correct middle vault collapse and prevent postoperative pinching. Costal cartilage can be very effective as spreader grafts because it is long, strong, and of adequate thickness. These grafts span from the caudal edge of the nasal bones to the anterior septal angle. The cephalic edge of the graft is beveled and positioned just under the caudal edge of the nasal bones. This edge is also narrower to reflect the natural contour of the middle vault, which is slightly wider at the osteocartilaginous junction and narrows near the anterior septal angle. Septal, auricular, or costal cartilage can be used for spreader grafts.

The position of the middle vault is noted before placement of the grafts so that asymmetries can be corrected. If one side of the middle vault is more concave, then a thicker graft or multiple spreader grafts can be placed on the deficient side. Two 5-0 PDS mattress sutures are placed through the grafts and the septum for fixation. The dorsal aspect of the spreader grafts can be trimmed so that it is level with the dorsal nasal septum, which will then translate to a smooth nasal profile. Correction of middle vault collapse and symmetry is then confirmed by visualization and, what is more important, by careful palpation.

Spreader grafts can also be placed using an endonasal approach. An incision is made high on the nasal septum at the junction of the upper lateral cartilages. The mucoperichondrium is elevated off of the septal cartilage. The grafts are then placed in a tight pocket with the upper edge of the spreader graft lying under the caudal edge of the nasal bone.

When the graft is in the correct position, the surgeon will observe an improved airway at the internal nasal valve and a corresponding change in the position of the upper lateral cartilage. This is because when the attachment between the upper lateral cartilage and the dorsal septum is intact, placement of the spreader graft endonasally will provide a cantilever effect on the upper lateral cartilage, moving it away from the septum and thus increasing the width of the internal nasal valve.[2]

Many patients are also noted to have supraalar pinching preoperatively, even in primary rhinoplasty cases. Alar batten grafts are used to support the lateral wall of the nose, which will help prevent postoperative lateral wall collapse. Such use of alar batten grafts will maximize the functional outcome after rhinoplasty and help prevent the typical supraalar pinching seen many years after rhinoplasty.

An alar batten graft on the surface of the nose demonstrates placement where the supraalar pinching is most pronounced. Note how the grafts are placed along the supraalar grooves.

As mentioned previously, alar batten grafts are placed in a precise pocket at the point where the supraalar pinching is most pronounced.[2] There is a tendency to place these grafts too far cephalic, which will cause deformity and not correct the lateral wall weakness. Conchal cartilage is a good choice for these grafts because the natural curvature of this cartilage can be used to one's advantage, with the convex surface oriented laterally.

Alar batten grafts can also be used to fill the space no longer occupied by lateral crura that have been repositioned caudally. With repositioning of the lateral crura an unsupported area of mucosa is created near the internal nasal valve. After repositioning the lateral crura more caudal, it is a good idea to place a thin flat alar batten graft over this area to support the internal nasal valve. Thin slivers of septal or costal cartilage are ideal for this type of alar batten graft. Care should be taken to make sure this graft does not create fullness along the sidewall of the nose.

Alar batten grafts provide a different purpose than lateral crural strut grafts. Lateral crural strut grafts are used to flatten and strengthen bulbous lateral crura, provide support to repositioned lateral crura, and support weakened lateral crura.[8] Alar batten grafts are used to provide lateral wall support independent of the lateral crura.

Profile Alignment

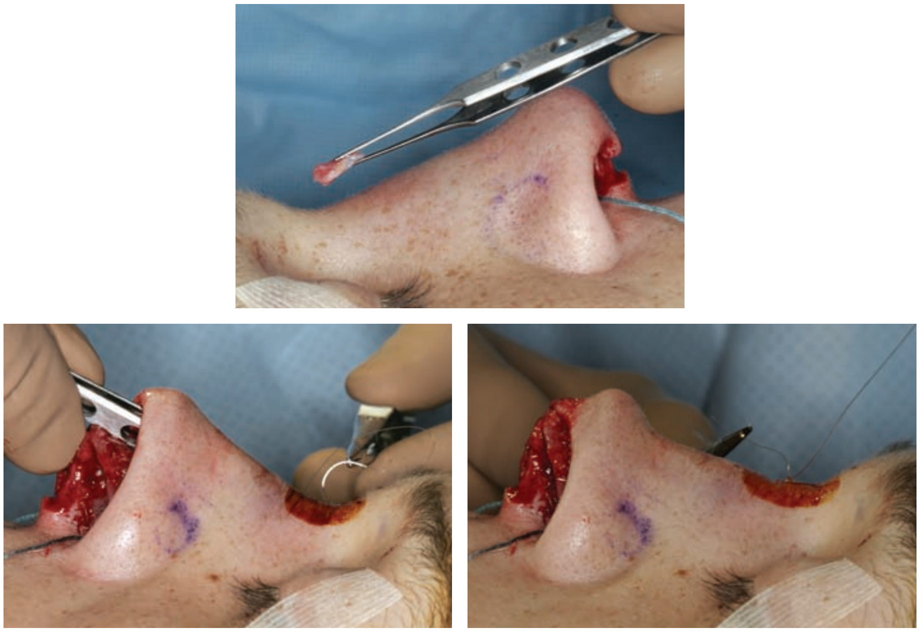
During the preoperative analysis, the need for profile alteration or nasal bony work is ascertained. When evaluating the nasal profile, the relationship of the nasal projection to the upper and lower thirds of the face is assessed. For example, in an overprojected nose with an underprojected chin, the surgeon can vastly improve the balance of the profile with chin augmentation.

When adjusting the nasal profile and/or bony nasal vault, the relationship of the nose to the upper and lower thirds of the face must be evaluated.

If dorsal hump reduction or osteotomies are planned, they are performed before septoplasty is completed. Typically we will divide the upper lateral cartilages from the dorsal septum and raise the mucoperichondrial flaps to expose the nasal septum and perform the dorsal hump reduction and osteotomies before removing any septal cartilage. This leaves maximal septal support and minimizes the chance of disrupting the keystone area where the dorsal septum meets the ethmoid bone.

Most dorsal humps are cartilaginous and are conservatively reduced with the use of a Rubin osteotome or a No. 15 blade. To decrease the chance of excessive dorsal hump resection, a 2 mm straight osteotome is used to make multiple small perforations in the bone at the proposed cephalic extent of hump reduction. Then a Rubin osteotome is used to take down the dorsal hump. With the perforations made at the superior extent of the dorsal hump reduction the bone breaks at that point maximizing control of the resection. Then a fine rasp can be used to smooth out the resection site to leave a smooth dorsal line. In most patients with very small dorsal humps, a rasp is preferred because it is less likely to result in overreduction or irregularity. We prefer a higher nasal profile to avoid excessive dorsal reduction.

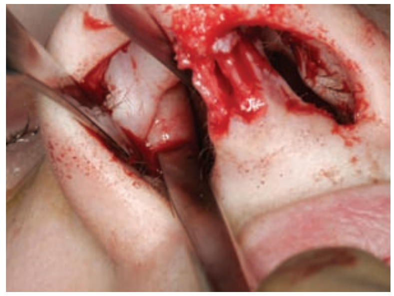
When needed, conservative reduction is recommended.



Radix grafting is also commonly used to achieve profile balance. The radix graft, composed of gently crushed cartilage, should be placed into a narrow subperiosteal tunnel to minimize the chances of graft movement off midline. They are placed at the end of the procedure to reduce the risk of displacement. A 5-0 Monocryl suture can be used to fixate the radix graft into the pocket by grasping the graft while holding it with a long forceps to make sure it is placed into the proper position.

When the width of the bony nasal vault needs to be adjusted, lateral osteotomies, with or without medial osteotomies, are performed. A 3 mm straight osteotome is used, which helps decrease the trauma to the soft tissue. The specific osteotome used should be based on the surgeon's comfort level with the maneuver.

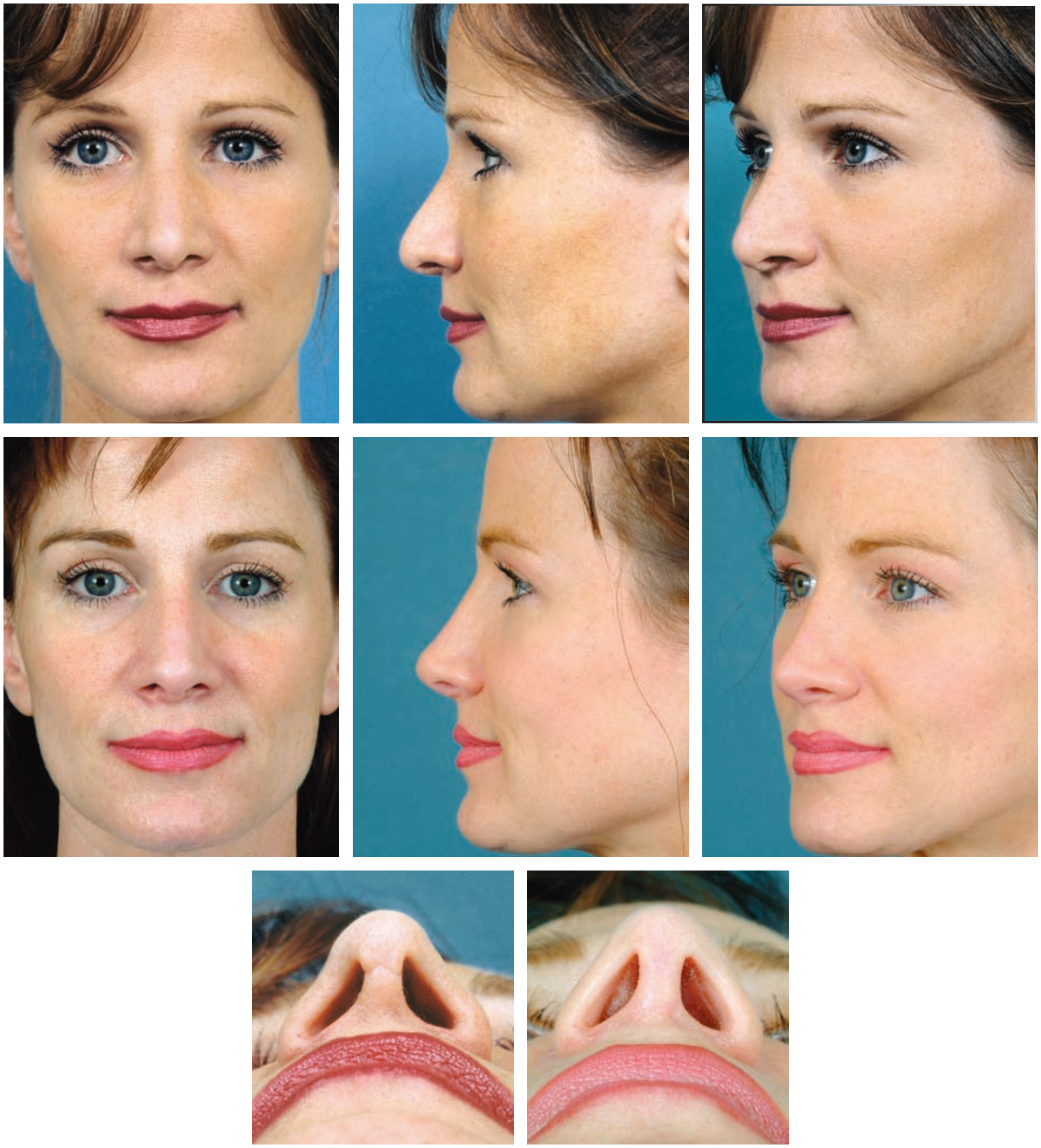
Osteotomies

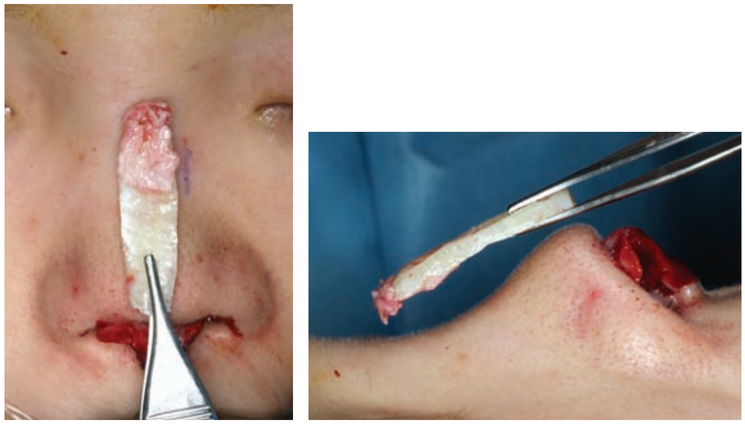

Before a lateral osteotomy is performed, the site is reinjected with local anesthetic. An intranasal incision is made along the piriform aperture, through which the osteotome is placed. We prefer a high-low-high lateral osteotomy, which is started approximately 2 to 3 mm above the base of the piriform aperture and ends at the level of the medial canthus.[6] A fading medial osteotomy is started 1 to 2 mm lateral to the midline. We only rarely do medial osteotomies as we feel most patients' nasal bones can be controlled using bilateral lateral osteotomies and digital manipulation. After dorsal hump reduction, medial osteotomies may not be necessary, because the patient already has an open roof. Once the osteotomies are performed, the nasal bones are shifted to appropriate symmetry and nasal width.

Dorsal Augmentation

The degree of dorsal augmentation necessary should be used as a guide for determining the type of cartilage to be used. In cases that require a modest amount of augmentation, septal cartilage is a good option. If properly shaped a single layer of septal cartilage will provide a natural appearing dorsum. Auricular cartilage can also be used; however, it has a tendency to curl at its edges despite precise carving. Pieces of auricular or septal cartilage can also be stacked and sutured together using a 6-0 Monocryl to provide additional dorsal height. In all cases, the grafts should be made narrower and thinner at their ends to create a more natural hourglass shape of the dorsum on the frontal view.[6]



This patient underwent several previous reductive rhinoplasties. As a result of the multiple surgeries, the patient was left with a redundant skin–soft tissue envelope. To correct the problem, structure was added to her nose including dorsal augmentation and tip reconstruction. A layer of septal cartilage was placed on her dorsum. A shield tip graft and lateral crural grafts were used to expand her thick nasal tip skin. She is shown 2 years postoperatively.



In cases where further augmentation is desired, costal cartilage is used. The risk of warping or irregularities can be reduced by carefully carving the graft and fixating the dorsal graft to the bony dorsum. The dorsal graft is carefully carved while observing for a defined curvature of the graft. The costal cartilage graft is soaked in antibiotic solution or in the dorsal pocket between carving sessions. It is recommended to carve the graft so that it has a slight convexity, the concave side should be placed inferiorly along the nasal bones to better approximate the natural dorsal contour.[5,10] With the concave margin placed inferiorly, the skin and soft tissue will help counteract any tendency to warp or bend upward.

When making the pocket for the dorsal graft, a very tight midline subperiosteal pocket is created to maximize fixation of the dorsal graft to the underlying bony dorsum. A key maneuver is to suture a layer of perichondrium to the undersurface of the superior aspect of the dorsal graft. Then multiple perforations or holes can be made in the bony dorsum where the dorsal graft will be placed to create a rough bone surface with exposed cortical bone. This rough surface of bone will adhere to the perichondrium and fix the dorsal graft to the bony dorsum creating an immobile graft.

Immobilizing the dorsal graft is the key to avoiding warping or displacement. The dorsal graft can also be fixed to the upper lateral cartilages with 5-0 PDS sutures placed bilaterally. Once placed, the graft is carefully palpated to assess for any irregularities or asymmetries. The graft is fixed in at least two points inferiorly to the upper lateral cartilages using a 5-0 PDS suture. A tight dorsal pocket essentially acts as an additional superior fixation point. If a tight subperiosteal pocket is not possible then the dorsal graft can be fixed using a percutaneous threaded K-wire left in place for a week or by making holes in the bony dorsum and placing a suture over the top of the dorsal graft to make it adhere to the underlying bone.[10]

When a small degree of dorsal augmentation is desired, septal or auricular cartilage may be used. Costal cartilage can be carved to achieve a larger amount of dorsal augmentation. The key to preventing displacement or warping of the dorsal graft is rigid fixation to the underlying bony dorsum.

The dorsum can also be augmented with alloplastic implants. Worldwide, commonly used allogenic materials include silicone, Gore-Tex, and Medpore. However, we do not use alloplastic implants in rhinoplasty. Although many patients who have had rhinoplasty with alloplastic implants are without problems or deformity, there is a subset of patients who suffer disturbing and, at times, serious complications. These patients present with various complaints, including infection, extrusion of the implant, skin thinning or necrosis, and localized pain. The inclusion of costal cartilage as an option for autologous grafting material has obviated the need to use alloplastic implants.

Alar Base Reduction

Before the nose is closed, the need for alar base reduction is assessed. In the white nose, the width of the alae should approximate the intercanthal distance. The alar width may be slightly greater in the ethnic nose. The nostrils may enlarge and flare as a result of the use of structural grafts such as alar rim and lateral crural strut grafts. To downsize the nostrils and decrease flare, a small triangular segment of skin can be removed near the junction between the alar and nostril sill. To prevent visible scarring, the skin edges are beveled by about 10 degrees to enhance eversion of the skin edges and prevent notching. If the skin edges are beveled and not closed properly, the scar will be visible. Electrocautery should also be avoided at this site because there is a risk of atrophy of the underlying subcutaneous tissue, with subsequent depression of the scar. Violation of the nostril sill can be very deforming and is fraught with hazard if not executed properly.

To decrease alar flare it is preferred to make a lateral alar resection near the base of the ala.

This excision is made above the alar groove to allow slight eversion of the closure. Placement of the incision in the alar groove can result is unsightly scarring.

The area to be excised is marked and injected with local anesthetic. The alar base reduction is carried out using a No. 11 blade. The skin incision is slightly beveled so that the skin edges are everted when closed. The cutaneous tissue is reapproximated using a 5-0 PDS suture, and the skin is closed with a 7-0 nylon vertical mattress suture. Special care is taken to evert the skin edges; otherwise, the scar will be visible. A 4-0 chromic suture is used to close the innermost aspect of the incision. Sutures at the point of the bevel should be left in place for 10 days to 2 weeks to allow for longer healing time and greater wound strength.

There are several points to consider when performing alar base reduction. The excision and closure must be performed carefully because these scars can be unsightly if performed incorrectly. When performing alar base reduction, one should always err on the conservative side so as to never overresect and create deformity. Preoperatively the patient should be informed of the possibility for alar base reduction, and that these incisions may be erythematous for many months, especially in dark or thick, sebaceous skin.

The need for alar base reduction is assessed at the end of the procedure. When performed, meticulous technique and the avoidance of cautery will help to reduce the risk of visible, unsightly scars.

Closure

Once the desired changes have been made, the nose is closed. A 6-0 Monocryl suture is placed subcutaneously at the midcolumellar region, followed by 7-0 nylon vertical mattress sutures interspersed with 6-0 fast absorbing gut suture. The infracartilaginous incision is then closed. There are cases in which the infracartilaginous incision cannot be closed primarily (for example, lengthening of a foreshortened nose). A composite graft placed intranasally can then be used

to facilitate closure. The septum is closed with a running 4-0 plain gut quilting suture, keeping the sutures loose enough to avoid compromise to the blood supply of the mucoperichondrial septal flap. Steri-Strips and an external cast are applied. A small piece of antibiotic-coated Telfa followed by a triangular vestibular splint is placed in each nare.

POSTOPERATIVE FOLLOW-UP

Rhinoplasty patients are followed closely in the postoperative period. The patient is discharged on the day of surgery with a prescription for oral antibiotic agents. The patient is instructed about ways to reduce postoperative edema: elevating the head of the bed, following a low-salt diet, and to avoid overheating. The nasal packing and splints are carefully removed on the first postoperative day. The patient is instructed to gently clean the nose and incisions and then to place antibiotic ointment in these areas. The cast and sutures are removed on the seventh postoperative day. If alar base reduction was performed, several sutures are left in place medially near the beveled part of the incision for 10 days to 2 weeks to increase the strength of the closure.

The nose is carefully assessed at each postoperative examination. Nasal exercises may be employed to reduce localized swelling and subtle asymmetries. Patients with significant preoperative lateral wall weakness and/or nasal airway obstruction may be instructed to wear vestibular splints at night. The splints will help to improve the airway if lateral wall grafts were used. When there is supratip fullness, the patient may be instructed to tape the area at night. In some cases, a low-dose steroid (triamcinolone acetonide, 10 mg/ml) will be injected subdermally. Care should be taken to be certain that the volume of steroid is small (0.1 to 0.2 ml) and that the injection is deep to the dermis to reduce the risk of subdermal atrophy.[6]

The rhinoplasty patient is followed closely postoperatively. During each examination, an assessment is made as to whether interventions such as nasal exercises, taping, and vestibular splinting are necessary.

The nose will heal over a long period of time. The initial edema will be reduced to an acceptable level by approximately 6 weeks postoperatively. Preoperatively the patient is told that the nose will be approximately 40% to 50% healed at 1 year postoperatively and will continue to heal over the patient's lifetime. The degree of healing is determined, to a great extent, by the thickness of the nasal skin and magnitude of structural support. Noses with thick skin that are well supported will tend to change less over time than those with thin skin and poor support.

After rhinoplasty, the nose can heal over the patient's lifetime. Patients with thicker skin will stabilize sooner, whereas in patients with thin skin the nose can change dramatically over time. Long-term follow-up is critical to maximizing patient outcome.

COMPLICATIONS

Possible complications after rhinoplasty include those related to graft harvesting and those related to the surgery itself. Risks associated with auricular cartilage harvest include localized pain, numbness, anterior conchal skin necrosis, auricular deformity, bleeding, hypertrophic scarring, and keloid formation. Use of a postauricular incision to harvest the conchal cartilage can reduce the incidence of visible scarring or deformity. Infection (including pneumonia), pneumothorax, pain at the harvest site, hypertrophic scarring, chest deformity, bleeding, and breast implant damage or rupture are all risks associated with costal cartilage harvesting. Meticulous technique and an understanding of the anatomy at the donor sites help reduce the risk of complications.

Postoperative complications after rhinoplasty include bleeding, infection, graft visibility, warping or displacement of grafts, and nasal valve collapse or obstruction. Carving a graft over the course of the procedure will allow the surgeon to assess for any tendency for the graft to warp. As the nose after rhinoplasty continues to heal over the patient's lifetime, the effects of scar contracture can lead to graft visibility and collapse of the middle vault/lateral nasal wall. The structure approach to rhinoplasty allows the surgeon to minimize these negative forces intraoperatively. With the techniques discussed earlier, structural grafting and camouflage of grafts in areas most at risk for visibility should reduce the risks of such complications.

CONCLUSION

Rhinoplasty is one of the most challenging procedures that plastic surgeons perform. The surgeon is not only faced intraoperatively with variations in nasal anatomy but also must try to counteract the effects of scar contracture postoperatively that, over time, could result in such problems as graft visibility, nasal deformity, and/or airway obstruction. The structure approach to rhinoplasty enables the surgeon to support the nasal framework and control the position of the nasal tip, which will resist the negative effects of scar contracture over the patient's lifetime.

Preoperative assessment and planning are also essential in achieving success in rhinoplasty. The use of computer imaging enhances the discussion between the patient and the surgeon. The surgeon must understand the aesthetic and functional goals for each patient before surgery.

We have detailed our approach to rhinoplasty, in which the framework of the nose is supported by means of structural grafts. Suturing and camouflage techniques are also used to achieve the desired results. The grafting methods discussed are well tolerated. The underlying philosophy of supporting the nose and controlling tip position is applied to both primary and secondary rhinoplasty.

KEY POINTS

- Rhinoplasty is a complex operation that requires careful preoperative planning and assessment, meticulous execution of the procedure, and an understanding of the natural forces from scar contracture that can lead to less than ideal results.
- The structure approach to rhinoplasty refers to the use of structural grafting techniques that support the nose in areas that have a predisposition for weakness or collapse postoperatively.
- Autologous cartilage is used as grafting material for rhinoplasty. The three main sources of cartilage are from the septum, auricle, and rib. Costal cartilage is frequently used in reconstructive and secondary rhinoplasty to provide maximal structural support and long lasting outcomes.
- Computer imaging can assist the surgeon in discussing the proposed changes with the patient. Surgeons are cautioned against showing changes that are unrealistic or beyond their capabilities.
- The nasal base is stabilized by means of one of several techniques. These include (1) medial crura fixation onto an overlong midline caudal septum, (2) a columellar strut graft, (3) a caudal septal extension graft, and (4) an extended columellar strut graft. Costal cartilage is frequently used for caudal extension grafts and extended columellar struts. The decision to employ one technique over the others depends on the specific anatomy and goals for each case.
- The nasal lobule is altered to achieve a natural-appearing contour with favorable shadowing and a horizontal tip orientation. The domes should take on a horizontal orientation, avoiding shadows lateral to the domes, which act to isolate the tip and create a pinched appearance on frontal view. There should also be a subtle supratip shadow that continues into the supraalar groove. One should avoid pinching of the nasal tip with a sharp demarcation between tip lobule and alar lobule. There are several methods and grafts that can be used to refine the nasal lobule. These include dome-binding sutures, lateral crural strut grafts, tip grafts, and alar contour grafts.

- A shield-shaped tip graft can increase tip definition and projection. Whenever a tip graft is used, methods to camouflage the graft must also be employed. These include the use of grafts (buttress and lateral crural grafts) as well as covering the leading edge with perichondrium and/or crushed cartilage. Tip grafts should be avoided in patients with thin skin because the risk of graft visibility is high.
- When adjusting the nasal profile and/or bony nasal vault, the relationship of the nose to the upper and lower thirds of the face must be evaluated.
- When needed, conservative reduction is recommended.
- When a small degree of dorsal augmentation is desired, septal or auricular cartilage may be used. Costal cartilage can be carved to achieve a larger amount of dorsal augmentation. Rigid fixation of the costal cartilage dorsal graft is key to avoiding warping or displacement.
- The need for alar base reduction is assessed at the end of the procedure. When this is performed, meticulous technique and the avoidance of cautery will help to reduce the risk of visible, unsightly scars.
- The rhinoplasty patient is followed closely postoperatively. During each examination, an assessment is made as to whether interventions such as nasal exercises, taping, and vestibular splinting are necessary.
- After rhinoplasty, the nose can heal over the patient's lifetime. Patients with thicker skin will stabilize sooner, whereas patients with thin skin can change dramatically over time. Long-term follow-up is critical to maximizing patient outcome.

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Guyuron's Approach

Bahman Guyuron

The goal of a rhinoplasty procedure is to create an aesthetically pleasing nose that is in harmony with the rest of the face. Thus a circumspect assessment of the entire face is crucial, because imperfections of other parts of the face can tremendously detract from the nose. Regardless of the magnitude of changes in the nose, its congruity with other facial structures helps to prevent a *surgical nose*. The other cardinal rule for a successful rhinoplasty is to create an optimal balance between different segments of the nose itself.

PREOPERATIVE ASSESSMENT AND PLANNING

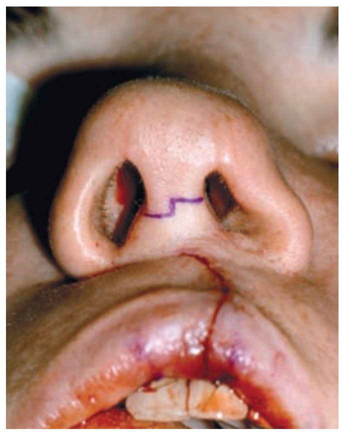
A precise facial analysis is the most important initial step for a pleasing rhinoplasty outcome. The nose and face are evaluated in three dimensions, and findings are confirmed with careful soft tissue cephalometric analysis of life-size photographs.[1]

It is vital to complete a precise patient analysis to ensure a successful rhinoplasty.

OPERATIVE TECHNIQUE

The procedure is almost exclusively performed with the patient under general anesthesia. If a turbinectomy is part of the plan, 0.5% lidocaine (Xylocaine) containing 1:200,000 epinephrine is first injected in the turbinates using a 25-gauge spinal needle. The nose is packed with a piece of gauze saturated in oxymetazoline (Afrin).

The gauze is placed as far posteriorly and cephalically as possible, to the area where the injected local anesthetic may not adequately diffuse to produce as much vasoconstriction as needed. The rest of the nose is injected with lidocaine containing 1:200,000 epinephrine circumferentially and in an organized manner to ensure sufficient vasoconstriction. The soft tissues along the lateral and medial surface of the nasal bones are injected profusely. The columella and the dorsal portion of the septum are injected bilaterally. The septum is injected along the floor of the nose as far posteriorly and caudally as possible to reduce bleeding during the septoplasty. The injection is repeated after several minutes using lidocaine containing 1:100,000 epinephrine to minimize the potential for a systemic reaction. Injection of lidocaine with this high concentration of epinephrine as the first step can often induce hypertension, tachycardia, and arrhythmia.



A stair-step incision is made in the columella and continued along the caudal margin of the medial and lateral crura of the lower lateral cartilages. I have found that this incision provides the least visible scar and the best alignment of the wound margin. Using a pair of baby Metzenbaum scissors and a spread and cut technique, the soft tissues overlying the medial crura and the domes are dissected. The dissection is continued cephalically to expose the lateral crura. On patients with thin skin, I save as much soft tissue on the skin flap side as possible. Alternatively, on patients with thick skin, it is preferable to raise a healthy skin flap with robust circulation and preserve some of the fibrofatty tissue between the domes to be dissected and discarded later. The dissection is continued along the dorsum using Metzenbaum scissors to the nasal bones.

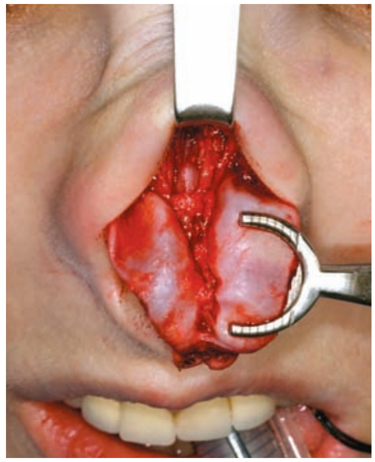
I have found that a stair-step incision provides the least visible scar and the best alignment of the wound margin.

At this point, the Obwegeser periosteal elevator is used exclusively, and every effort is made to maintain the dissection in the subperiosteal plane. Preservation of the periosteum will protect the overlying muscles, provide a more natural shape to the nose, and reduce the visibility of residual nasal imperfections. Violation of the periosteum and thinning of the soft tissues may result in visibility of minor dorsal flaws, including potential dimpling of the nose skin on animation, and telangiectasias, a common displeasing sequela of a suboptimally conducted primary rhinoplasty.

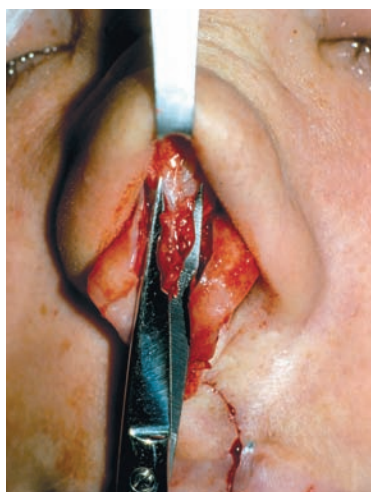
Preservation of the periosteum is vital to protect the overlying muscles, provide a more natural shape to the nose, and reduce the visibility of residual nasal imperfections. Violation of the periosteum and thinning of the soft tissues may result in visibility of the minor dorsal flaws, potential dimpling of the nose skin on animation, and telangiectasias.

After the periosteum is sufficiently elevated, a guarded burr is used to deepen the radix, if needed.[2] To prevent penetration of the frontal sinuses, the burr is gently moved from side to side while it is running, rather than cephalocaudally. The dorsal hump is then reduced. It is often necessary to first remove a portion of the hump if it is large. Otherwise, it may be difficult to advance the guarded burr to the desired site. The deepest portion of the radix is centered at the level of the upper tarsal crease.

The push and pull rasp is then used to remove the bony hump. The rasp is angled toward the cheek to minimize the potential for inadvertent fracture of the septum, which is more likely to occur if rasping is performed in a cephalocaudal direction. In addition, the bones are protected by the left index finger and thumb in such a way that the frame will not be damaged easily if the rasp slips. Rasping is continued until the bony dorsum appears optimal.



A lateral crus stabilizer (Black & Black Surgical, Inc., Tucker, GA) is then used to stabilize and fix the lower lateral cartilages. The excess portion of cartilage is removed, maintaining about a 4 mm width of lower lateral cartilage anteriorly and 6 mm or more posteriorly.[3] The incision is made with a No. 15 blade. Iris scissors are used to dissect and remove the excess cartilage. The mucoperichondrium needs to be maintained intact. If the removed cartilage is thick and rigid enough, it can be used as an alar rim graft or to support the lateral crura.



On noses that are wide or have a large hump and removal will result in open roof, the soft tissue overlying the caudal septum is removed to access the caudal end of the upper lateral cartilages and the dorsum. The mucoperichondrium is separated from the nasal roof to prevent penetration of the lining, and a tunnel is created. This portion of the mucoperichondrium may act as an intrinsic spreader graft in patients who have only a very small dorsal hump (1 mm or less). The upper lateral cartilages are then divided from the dorsum on most patients, except those who

have a straight nose with minimal or no bumps. The upper lateral cartilages are employed as an autospreader flap in patients who have a large hump.

Next, septoplasty is performed by elevation of a left-sided mucoperichondrial flap. Occasionally it is necessary to make a small incision in the perichondrium anteriorly to enter into the correct plane between the septal cartilage and the perichondrium. Visualization of the glistening grayish cartilage ensures that the dissection is being performed in the interface between the mucoperichondrium and the cartilage. If the perichondrium is left attached to the cartilage, it will reduce the thickness of the residual septal lining and increase the potential for perforation. After the right plane is entered, it is very easy to continue the dissection cephalically and posteriorly. To begin elevation of the septal mucoperichondrium, the sharp end of the periosteal elevator is used initially, and after the correct plane is entered, the dull end is used for dissection, thus augmenting the safety of the procedure. Firm attachments of the mucoperichondrium along the dorsum may necessitate the use of a No. 15 blade to enter the correct plane.

To increase procedural safety, I use the dull end of a periosteal elevator for dissection after the correct plane is opened.

Separation of the medial crura may be a surgical goal for other reasons and can increase septal exposure. However, this is not necessary for the purpose of septoplasty alone. As the medial crura are separated, I remove some soft tissue located between the medial crura and the footplates, including the tip depressor muscle. The depressor septi nasi muscle pulls the tip caudally when a patient smiles, narrowing the columellar-labial angle. Removal of the soft tissues between the medial crura will stop this pull and allow subsequent approximation of the footplates without protrusion of the subnasale. After the full extent of the mucoperichondrium is elevated on the left side, the sharp end of the septal elevator is used to incise the septal cartilage, preserving an L-shaped strut for the dorsal and columellar support with at least 15 mm maintained dorsally and caudally. The dull end of the elevator will be used to enter between the mucoperichondrium and the cartilage on the right side. The dissection continues posterocaudally until the full extent of this part of the septal frame is exposed. Commonly, the posterior portion of the cartilage is found dislodged to one side of the maxillary crest. It is crucial to free and remove this portion of the cartilage from the perpendicular plate using the sharp end of the elevator. Often it is easier to start the dissection posteriorly and progress anteriorly, thus protecting the lining and sufficiently dissecting the entire posterior septum while preserving an L-shaped cartilage caudally and dorsally.[4]

It is crucial to free the posterior portion of the cartilage from the perpendicular plate with the sharp end of the elevator and remove the deviated portion of the cartilage.

If a small perforation in the mucoperichondrium is noted on one side of the septum, it is not necessary, nor is it prudent, to repair it. The opposing perforations may require replacement of some of the septal cartilage or the removed portion of the perpendicular plate to provide a scaffold for the mucosa to heal over, and to prevent free communication between the two nasal cavities. It is not necessary to repair the perforations by suturing; however, bilateral Doyle or Supramid Simple Splints (S. Jackson, Inc., Alexandria, VA) should be applied to facilitate healing.

Commonly, the maxillary crest of the vomer bone or the entire vomer bone is deviated and a spur is present on one side of the septum. It is essential to remove the deviated portion of vomer bone using a rongeur. Occasionally the anterior nasal spine is shifted and can be repositioned with an osteotomy, or it is protruding excessively, justifying its removal. It is also of cardinal importance to remove the excessive portion of the anterocaudal septum, which is dislodged to one side of the septum. This allows repositioning of the septum in the midline over the anterior nasal spine. A 5-0 PDS suture is then used to fix the septal cartilage to the periosteum of the underlying anterior nasal spine.

It is paramount to ensure that the anterior nasal spine is in the proper position (midline) before the cartilage is fixed to it. Otherwise the cartilage is repositioned on a faulty foundation that will invariably result in failure to correct deviation of the anterocaudal septum and columella.

The next step is to remove the excessive portion of the turbinates. The hypertrophic part of the inferior turbinates is removed using a pair of turbinate scissors conservatively to preserve an evenly shaped structure. Alternatively, the turbinate can be reduced using an XPS device (Medtronic, Minneapolis, MN). If only the anterior or the posterior portion of the turbinate is removed, the residual portion will hypertrophy and possibly protrude into the airway. The raw area is gently cauterized using suction cautery. The inferior turbinates can also be reduced with coblation (10 second duration, 6 mJ coblation, and 2 coagulation). Doyle stents are inserted and fixed in position by 5-0 Prolene sutures.

Doyle stents need to be inserted and fixed in position before the nasal bone osteotomy to ensure that the airway is patent and the nasal bones will not be displaced medially.

Next, a medial osteotomy is performed using a 4 or 6 mm osteotome. The device is first placed medial to the nasal bones and then advanced cephalically with gentle tamping using a mallet. A wedge of bone is removed medially to reposition the nasal bones, only if a significantly large distance exists between the nasal bones and the septum.

An anteroposterior osteotomy is then carried out percutaneously using a 2 mm osteotome. This requires palpation of the nasal bones to identify the diverging point of the bones, which is the osteotomy site. The surgeon need not depend on arbitrary landmarks such as the medial canthus, which may or may not correspond to the point where the nasal bones begin to widen. The osteotome is inserted through a single puncture wound fairly anteriorly to prevent injury to the angular vessels. It is then directed posteriorly and cephalically under the periosteum. Several interrupted osteotomies are made. The vestibular lining is incised laterally, and the periosteum is elevated using a Joseph periosteal elevator. We are convinced from our craniofacial experience that protection of the periosteum significantly reduces periorbital ecchymosis.

When performing an anteroposterior osteotomy, the surgeon should palpate the nasal bones rather than rely on the medial canthus or other anatomic references, because these may or may not have relevance to the point where the nasal bones begin to widen.

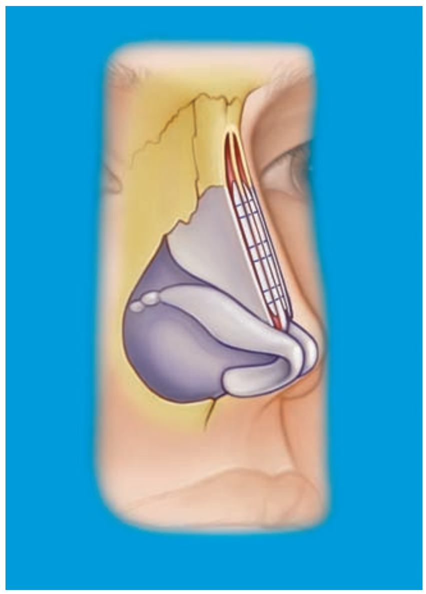
A low-to-low osteotomy at the junction of the nose and face is carried out using a guarded osteotome. This osteotomy is placed posterior to the natural suture line. Part of it is in the frontal process of the maxilla to prevent a step deformity, a commonly seen imperfection in secondary rhinoplasty cases. If the anterior portion of the inferior turbinate extends anterior to the plane of the osteotomy, a high-to-low osteotomy is preferred to prevent medialization of the inferior turbinate. It is important not to trim the upper lateral cartilages until the septum and nasal bones have been repositioned. We have often found it necessary to trim the upper lateral cartilages differentially after completing the osteotomy, especially if the nose is deviated.

The upper lateral cartilages should not be trimmed until after the septum and nasal bones are repositioned.

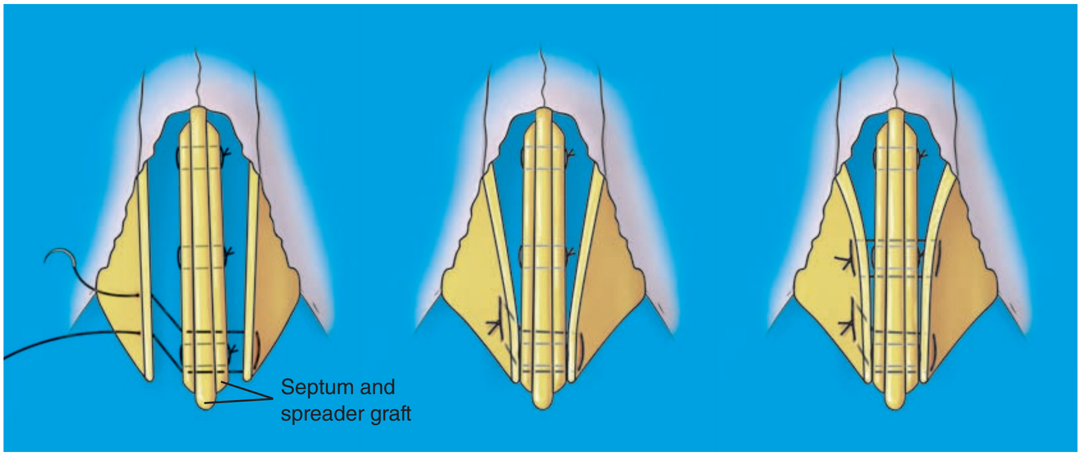
Cartilage grafts are designed next. It is crucial to economize the use of removed septal cartilage and design pieces that will serve the plans most suitably. For example, if a straight piece of cartilage is needed for the columellar strut, then that

will become my top priority. The spreader grafts are then prepared. Most patients have a potential for a middle vault collapse after the dorsal hump is removed and an osteotomy performed, especially if the hump is large, and will benefit from placement of spreader grafts.

Economic use of the removed septal cartilage is crucial. Graft pieces are designed that will serve the plans most suitably. For example, if a straight piece of cartilage is needed for the columellar strut, then that will become my top priority.



The ends of the spreader graft are beveled to prevent a step deformity related to the use of these grafts. Spreader grafts are placed and fixed in position using a double-armed 5-0 Vicryl stitch. After the needles are passed through the cartilage, the necessary adjustments are made before the sutures are pulled through to ensure that the spreader grafts are precisely aligned with the dorsum before final fixation. Generally, the graft is fixed with two (and sometimes three) sutures. This prevents rotation or dislodgement and firmly approximates the cartilage graft to the septum.



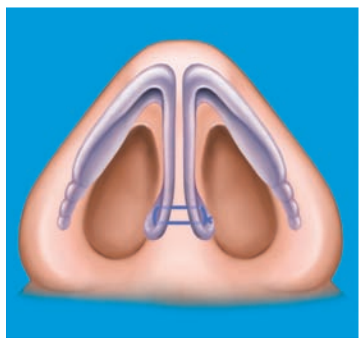
One of the most crucial parts of this operation is reattachment of the upper lateral cartilage to the septum. If the septum is deviated anterocaudally, a septal rotation suture is placed.[5] When a mattress suture is placed to approximate the upper lateral cartilages to the septum, it is passed more cephalically on the opposite side of the deviation. As the suture is tied, it will rotate the septum to the midline.[4,5] It is often necessary to place a second suture to prevent bowing of the upper lateral cartilage. These mattress sutures are placed as far anteriorly as possible to prevent narrowing of the internal valve by the suture.

After the needles are passed through the cartilage, the necessary adjustments are made before the sutures are pulled through. This maneuver ensures that the spreader grafts are precisely aligned with the dorsum before the final fixation.

If indicated, a tip rotation suture is placed. A wedge of anterocaudal septum is removed to allow rotation of the nasal tip. A columellar strut is placed in position and secured across the columella using a 25-gauge needle while the domes are pulled anteriorly with a wide double hook to guide placement of the medial crural sutures. This maneuver ensures that the domes and medial crura are aligned properly, and the columellar strut is positioned precisely. For fixation of the columellar strut, 5-0 PDS sutures provide a sufficient period of stability until scar tissue forms. Two sutures are placed to fix the medial crura to the columellar strut to prevent rotation of the strut. Widening of the columella is commonly observed in secondary rhinoplasty patients; this probably results from the application of a columellar strut without placement of a medial crural suture along the caudal margin of the medial crura.

If the tip needs to be rotated cephalically, a triangular piece of cartilage and the membranous septum based anteriorly are excised from the caudal septum. The extent of excised soft tissue is equal to or slightly more than the amount of removed cartilage. The goal is to eliminate soft tissue redundancy that otherwise might promote caudal rotation of the tip.

A tip rotation suture can change the nasolabial angle and further fix the tip in the desired position. To rotate the tip, a 5-0 nylon suture is passed through the caudal or cephalic border of the medial crura and tied. If the suture is passed through the caudal border of the medial crura, the needle should be passed between the medial crura and then through the anterocaudal septum, and next is brought back between the medial crura. If the suture is passed through the cephalic border of the medial crura, it is passed directly through the anterocaudal septum. As the suture is tightened, the tip will rotate cephalically and remain securely in this position. This type of fixation is extremely important for senescent noses.

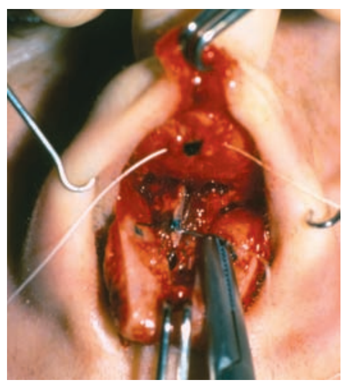


If the distance between the footplates of the medial crura needs to be narrowed, the excessive portion of the footplates is trimmed and approximated with a suture that is passed from one plate to the other through an incision in the membranous septum. As the suture is tied, it pushes the soft tissues of the subnasale caudally if the soft tissue has not been eliminated. It also produces more stability in the central portion of the basilar nasal tripod. The membranous septum incision is then repaired using a 5-0 chromic suture. The dead space between the footplates, caudal septum, and columellar strut is eliminated by a through-and-through suture placed at the level of the footplates.

Doyle stents are then fixed to the septum using 4-0 Prolene through-and-through sutures. These stents are usually kept in position for approximately 8 days and then removed before the external stents are extracted so that the nasal bones will not be inadvertently displaced.

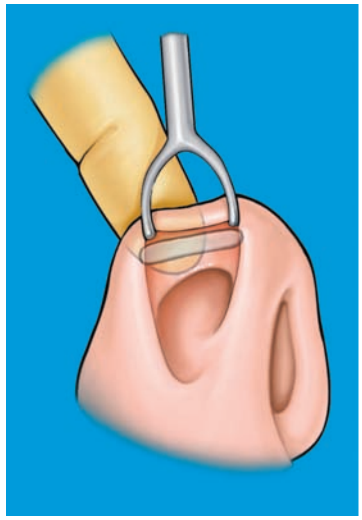
If the domal arches are too wide, a transdomal suture is used.[6,7] Lateral crural struts are placed by separation of the mucoperichondrium from the lateral crura and insertion of the graft under the existing lateral crura. The lateral crura are totally dissected and repositioned in a new pocket if they rotate cephalically.

If the domes are too far apart because of divergence of the medial genu, an interdomal suture is placed *(left)*. If the domes are too close to each other or are asymmetrical, a subdomal graft is applied *(right)*.[8]



The columellar incision is then repaired by 6-0 plain fast-absorbing suture. On patients with thick nose skin requiring a supratip suture *(above)*,[9] a temporary suture is placed through the columellar incision. The supratip break point is tattooed to mark the subcutaneous tissues and the anterocaudal septum, and then the temporary suture is removed. A supratip suture is then placed using 6-0 Monocryl to loosely approximate the subcutaneous tissues to the underlying supratip area.

The columellar incision is repaired by aligning the angles of the skin flaps, which provides a guide for precise suture placement using 6-0 fast-absorbing gut. Finesse is important to approximate the skin incision perfectly and prevent notching or irregularities.



Next, an alar rim graft is placed in the form of a piece of septal cartilage or the cephalic margin of the lower lateral cartilages, as long as it is strong and can serve this purpose. The anterior ends of the cartilage graft are beveled to prevent visibility of the graft and to provide an elegant transition from the alar rim to the tip. Iris scissors are used to create a pocket within the thickness of the alar rim, as close to the rim as possible. The graft is inserted and fixed in position using a 6-0 plain gut suture. Common placement of an alar rim graft is one of the most significant developments in rhinoplasty in recent years.[10,11] Dissection and transposition of the lower lateral crura with or without lateral crural strut grafts can be invaluable in patients with cephalically oriented lower lateral crura or retracted alae.

One of the most significant developments in rhinoplasty in recent years is the creation of a pocket using Iris scissors within the thickness of the alar rim in which the alar contour graft is inserted. Dissection and transposition of the lower lateral crura with or without lateral crural strut grafts can be invaluable in patients with cephalically oriented lower lateral crura or retracted alae.

The alar base is narrowed, if necessary.[12] The incision is designed to maintain the lateral portion of the nostril sill and provide a pleasing transition from the alar base to the nostril sill. This maneuver prevents notching or angulation that is inherent in many of the old rhinoplasty techniques. It is important to release the

alar base muscles to prevent potential widening and ease approximation of the alar base incisions. Attention to detail is crucial. I prefer to use 6-0 fast-absorbing gut sutures to repair the alar base incision (see Chapter 32).

Mastisol is then applied to the nose skin to facilitate adhesion of the Steri-Strips. A nose dressing is very important, because it helps to approximate the free portion of the soft tissues to the underlying frame and eliminate dead space, along with the supratip suture. Generally a combination of metal splints and Aquaplast is used over Steri-Strips. The Aquaplast portion of the splint provides stability, and the metal portion of the splint aids in precise molding of the Aquaplast.

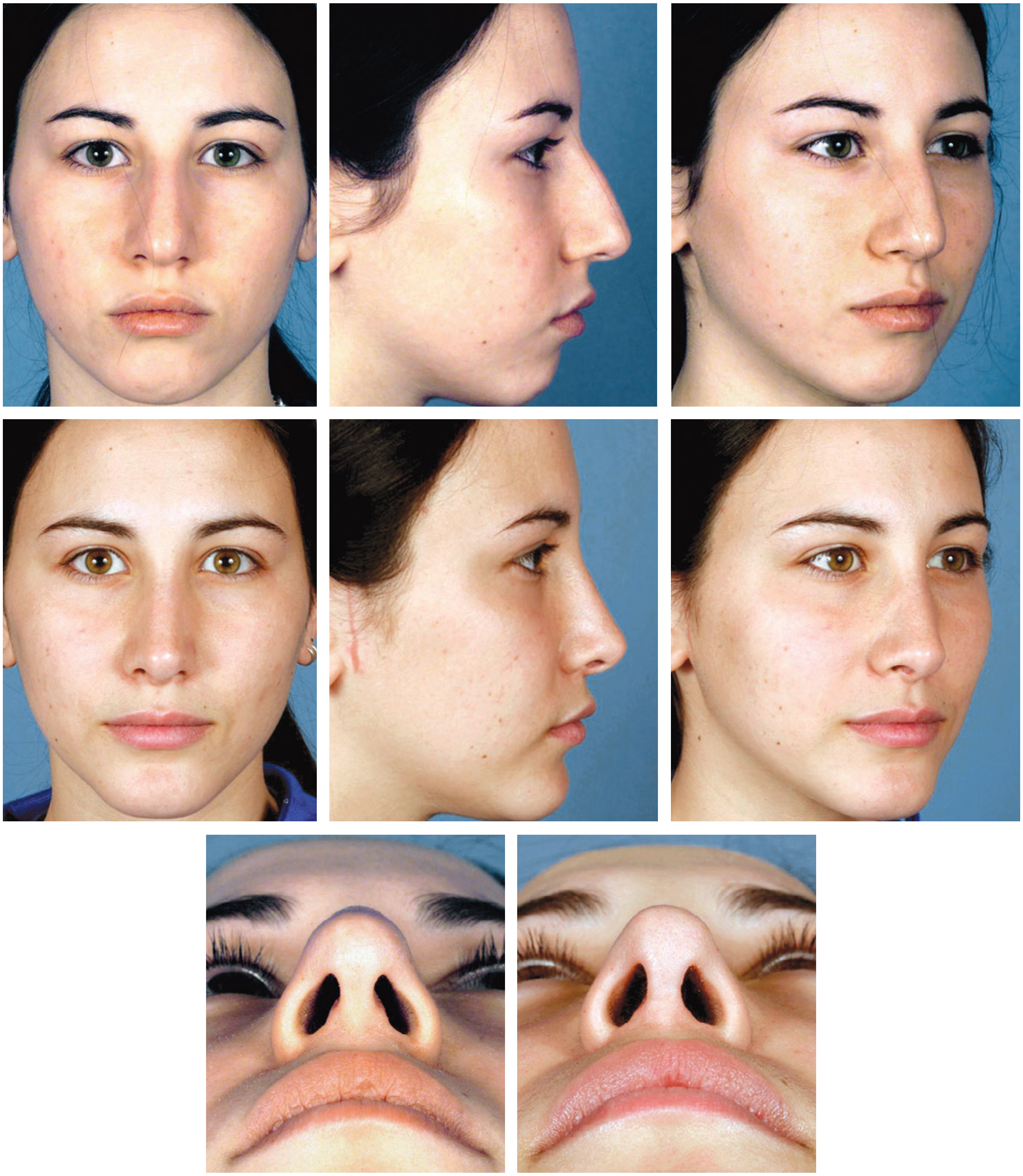
A nose dressing is a very important part of rhinoplasty; it helps to approximate the free portion of the soft tissues to the underlying frame.

CASE ANALYSES

This patient presented with posttraumatic nasal deformity with substantial deviation of the caudal nose to the right.

Through an open technique, the cephalic margin of the lower lateral cartilages was resected, the dorsal hump was removed, and osteotomies were performed bilaterally. Spreader grafts were applied bilaterally. A columellar strut was applied, and transdomal sutures were placed. A supratip stitch was placed, the alar bases were narrowed, and alar rim grafts were applied. This patient also had a septoplasty, conservative turbinectomy, and repositioning and fixation of the anterocaudal septum. He is shown 1 year postoperatively.

This patient requested rhinoplasty to correct her dorsal hump and to create a more aesthetic, balanced profile.



Through an open technique, the cephalic margin of her lower lateral cartilages was resected, her dorsal hump was removed, and her radix was lowered. Osteotomies were performed, and spreader grafts were applied bilaterally. The medial crura were approximated and anchored from the anterocaudal septum. Transdomal and lateral crural spanning sutures were placed, and a tip graft was applied. The patient is shown 2 years postoperatively.

POSTOPERATIVE CARE

The external splint is left in place for 8 days. Doyle stents are kept in place for the same length of time and are removed before the nose splint is removed. An oral systemic first-generation cephalosporin is continued while the Doyle stent is maintained in position. A postoperative Medrol Dosepak is prescribed to minimize swelling and bruising for patients who do not have contraindications such as severe acne. Patients are prohibited from heavy physical activities for 3 weeks and from wearing glasses for 5 weeks. No other limitations are required. Most patients do not require postoperative taping, although it may be needed for a small number of patients with supratip swelling.

CONCLUSION

With adherence to the principles discussed in this chapter, the incidence of revision rhinoplasty can be reduced, very often with gratifying results.

KEY POINTS

- It is vital to complete a precise patient analysis to ensure a successful rhinoplasty.
- I have found that a stair-step incision provides the least visible scar and the best alignment of the wound margin.
- Preservation of the periosteum is vital to protect the overlying muscles, provide a more natural shape to the nose, and reduce the visibility of residual nasal imperfections. Violation of the periosteum and thinning of the soft tissues may result in visibility of the minor dorsal flaws, potential dimpling of the nose skin on animation, and telangiectasias.
- To increase procedural safety, I use the dull end of a periosteal elevator for dissection after the correct plane is opened.
- It is crucial to free the posterior portion of the cartilage from the perpendicular plate with the sharp end of the elevator and remove the deviated portion of the cartilage.
- It is paramount to ensure that the anterior nasal spine is in the proper position (midline) before the cartilage is fixed to it. Otherwise the cartilage is repositioned on a faulty foundation that will invariably result in failure to correct deviation of the anterocaudal septum and columella.
- Doyle stents need to be inserted and fixed in position before the nasal bone osteotomy to ensure that the airway is patent and the nasal bones will not be displaced medially.

- When performing an anteroposterior osteotomy, the surgeon should palpate the nasal bones rather than rely on the medial canthus or other anatomic references, which may or may not have relevance to the point where the nasal bones begin to widen.
- The upper lateral cartilages should not be trimmed until after the septum and nasal bones are repositioned.
- Economic use of the removed septal cartilage is crucial. Graft pieces are designed that will serve the plans most suitably. For example, if a straight piece of cartilage is needed for the columellar strut, then that will become my top priority.
- After the needles are passed through the cartilage, the necessary adjustments are made before the sutures are pulled through. This maneuver ensures that the spreader grafts are precisely aligned with the dorsum before the final fixation.
- One of the most significant developments in rhinoplasty in recent years is the creation of a pocket using Iris scissors within the thickness of the alar rim in which the graft is inserted. Dissection and transposition of the lower lateral crura with or without lateral crural strut grafts can be invaluable in patients with cephalically oriented lower lateral crura or retracted alae.
- A nose dressing is a very important part of rhinoplasty; it helps to approximate the free portion of the soft tissues to the underlying frame.

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Gruber's Approach

Ronald P. Gruber

My personal approach to rhinoplasty is actually not very different from that of most colleagues, especially those who have provided their personal approaches in this book. However, nuances exist that I would like to share in hopes that readers will glean one or more pearls that they can apply in their practices. Many of these thoughts are not strictly mine[1-14]; I have drawn ideas and borrowed procedures from most all of my colleagues.[15-23] All of us in the field of medicine and surgery subconsciously get ideas at meetings and from communications with our peers. It is sometimes difficult to know whether we actually thought of the procedure ourselves. Therefore I find that the best policy is to give credit to everyone who may have been involved somehow, reference all the material pertinent to the operation, express gratitude openly and warmly to all the colleagues I have had the opportunity to work with over the years, and explain that the advances made in rhinoplasty are in large part a community project.

ANALYSIS

Computer imaging systems have made it possible to communicate much better with patients. I can determine what a patient desires by using this graphic information. A patient can in turn assess the morphed images to learn what I can or cannot do surgically.

By morphing pictures, a surgeon is in effect performing mock surgery. This is a learning process for surgeons in a general sense, because it allows them to appreciate the effects that changes to specific nasal structures have on the overall result. More specifically, this process provides information that can be helpful in devising a game plan (a list of techniques) for use in the operating room. The morphed pictures are given to a patient after the first consultation. Copies are taken to the operating room and referred to when the cartilaginous framework is sculpted. There is quite obviously an implied warranty with the use of morphed images, which I fully accept. However, over the years only a few dissatisfied patients have returned the original morphed pictures to me after healing was complete, with the complaint that I had not achieved the desired result. These patients were usually correct, and nasal revision was suggested. The process did not hamper the patient-doctor relationship or lead to medicolegal issues per se. Certainly none of us would have a home built without a set of blueprints from the architect. Therefore why fear giving nasal blueprints to a patient?

Analysis and morphing with any one of the computer imaging systems are extremely helpful. They enhance communication and offer an opportunity for mock surgery.

Evaluation of the Airway

A relatively simple approach to diagnosis of airway problems is as follows. The expiratory flow is tested, with one finger placed over a nostril. Expiratory obstruction is generally caused by a problem with the septum and/or turbinates. Valve problems affect inspiratory flow. The side walls can often be observed as they collapse. However, a more quantitative assessment involves the use of Breathe Right (BR) nasal strips. A strip is placed on the middle third of the nose, and

the patient is asked whether the airway is improved, aggravated, or not affected. The strip is removed, and a new one is placed on the rims (in effect, the external valves). The patient is asked the same question. The obstruction is then classified as one of the following:

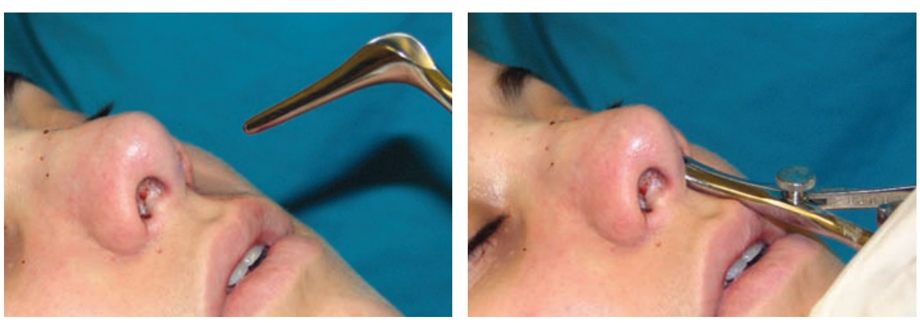
BR 0: No improvement or change in airflow
BR I: Improvement with a nasal strip on the middle third (internal valves)
BR II: Improvement with a nasal strip on the rims (external valves)
BR III: BR I and BR II

Airway obstruction from turbinate hypertrophy and malposition of the bony septum responds extremely well to septoturbinotomy, which is a simple, safe, noninvasive means of opening the airway.

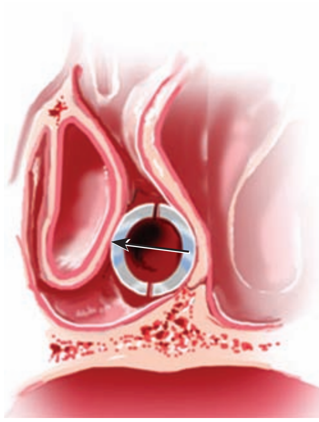
Placement of a nasal strip is also a mock surgery. If internal valve pathology is suspected and no improvement in flow results from placement of a nasal strip, the surgeon should consider an alternate diagnosis and be prepared for spreader grafts or splay grafts not to work. If a dramatic result is seen with the nasal strip on the middle third (internal valves), the result with spreader grafts (or splay grafts and sutures) is likewise likely to be dramatic.

Expiratory obstruction is generally caused by a problem with the septum and/or turbinates. Valve problems affect inspiratory flow.

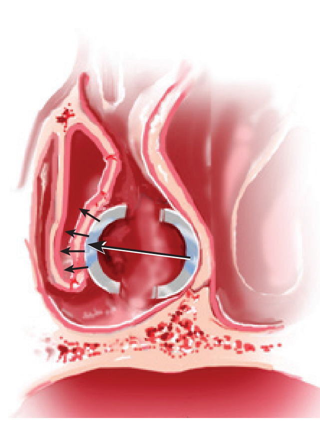
Septoturbinotomy



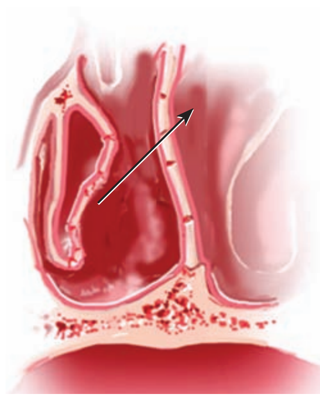
Years ago, Mal Lesavoy and I realized (as no doubt others did) that a simple spreading of the walls of the nasal vault could centralize a deviated bony septum and outfracture the turbinates. The airway can be opened with a large speculum (or another tool such as a large clamp or Pean clamp) that is inserted deep into the nasal cavity and spread forcibly.



Speculum placement



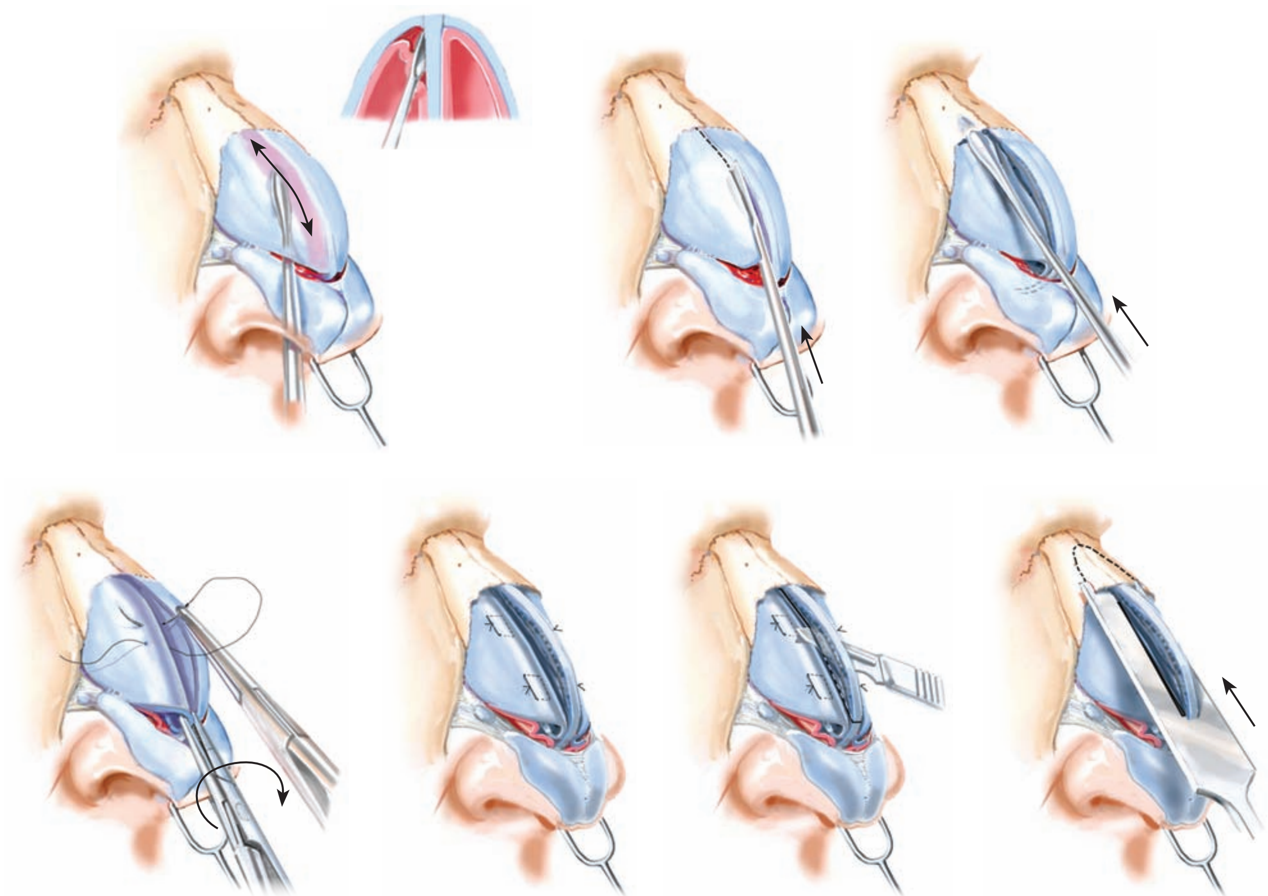
Turbinate outfracture



Bony septal fracture

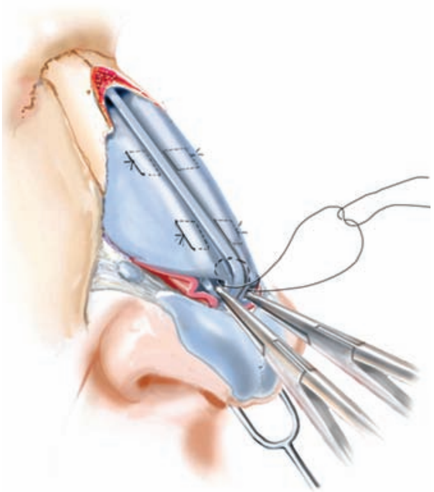
We have performed turbinate fracture alone for years with considerable success and have made it a routine part of our nasal surgery at the very beginning of each case. We learned that most if not all airway obstruction from these two entities (a deviated bony septum and large turbinates) can be corrected with this technique. Therefore actual turbinectomies became almost nonexistent in our practices. The contraindication to septoturbinotomy is the need to harvest cartilaginous septum for donor material. When the vault is spread with a speculum, septal cartilage can be fractured to pieces that are smaller than desired for donor material. Usually only an L-shaped strut remains after septal cartilage is harvested. Therefore septal cartilage is harvested first, and a septoturbinotomy is performed last and gently.

Spreader Flaps



Some years ago Bill Wood and I recognized that it might be possible to save the upper lateral cartilages in a humpectomy and fold them inward to serve as spreader grafts. We were not the only ones to come to this conclusion; numerous surgeons introduced essentially the same concept, modified it, and presented their results over the years.[24-37]

Spreader flaps in primary rhinoplasty can be used to rebuild the internal valves and preserve the aesthetic appearance of the middle third of the nose, thereby preserving donor cartilage that would have to be used for spreader grafts otherwise.



Today most surgeons recognize that a spreader flap (sometimes called an autospreader flap) is a useful means to save cartilage. It also makes the process of humpectomy easier, because once the upper lateral cartilages are out of the way, the hump can more precisely be removed. The only indication is the presence of a hump. Surprisingly, even extremely small humps usually can be corrected with this maneuver. Consequently, I seldom need spreader grafts in a primary rhinoplasty. However, spreader grafts are the benchmark for restoration of a functional and aesthetic middle third of the nose, thanks to Jack Sheen.

Donor Cartilage

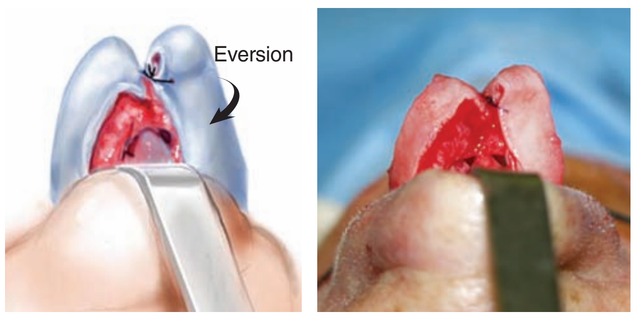
Almost all surgeons will agree that septum is the ideal material for grafting. Selection of a second choice is the problem. Ear cartilage has the disadvantage of being curved and weak. Rib has the disadvantages of potential warping, a more complex harvest, and the small possibility of pneumothorax. But when substantial cartilage is needed, nothing is superior to rib. My preference is costal cartilage harvested from an inframammary approach, because the scar is fairly inconspicuous. However, I typically harvest the anterior half with a septal knife (after elevation of the perichondrium) to prevent problems associated with complete rib removal. The warping potential is minimized by waiting until the cartilage reveals most of its intraoperative warping. At this point, the cartilage is scored or shaved to create the desired shape, which is usually straight. Donor site morbidity has not been a problem if the tissues are injected with Marcaine before closure.

Ear is a favorite cartilage donor site when large volumes are not needed. It is usually available. The concha cymba and concha cavum are harvested as a single unit from the posterior approach. The result is a kidney-shaped piece of cartilage that can do quite a lot of work. When the cymba is cut down the middle, two curved struts result. They make very good spreader grafts with the concave sides down. A horizontal mattress suture of 5-0 PDS or Vicryl on each side will stiffen and straighten the pieces of ear cartilage, creating effective struts for the lateral crus or columella. The concha cavum has a curvature that is actually helpful when making tip grafts. Scoring is not needed, as it is for tip grafts made of septal cartilage. The concha cavum can be used as a batten on the caudal end of the septum (concave side down) to elongate the nose.

Ear cartilage can be exceptional donor material if it is straightened with horizontal mattress sutures. The concha cymba can be split down the middle and straightened with horizontal mattress sutures to create a good columellar strut or lateral crural strut.

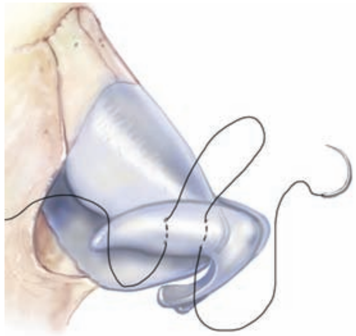
Tip-plasty

Since Daniel, Tardy, and Tebbetts began the modern era of suture tip-plasty, I joined in and learned how sutures can completely control the tip shape. Before I begin a tip-plasty, it is helpful to have a model from which to perform biologic sculpting. In art of any kind it is much easier to copy angles and measurements than to create them from memory.



An interdomal suture is required to restore tip symmetry and strength. I have found, however, that a transdomal suture (Daniel's domal definition suture) frequently needs to be modified to become a hemitransdomal suture. Typically the dome needs to be narrowed. Narrowing of the entire width of the dome (with a transdomal suture) inadvertently inverts the caudal rim of the lateral crus, potentially creating concave rims. A hemitransdomal suture acts to *evert* the lateral crus and minimize rim concavity, thereby minimizing the need for secondary corrective measures such as alar contour rim grafts. I prefer to use grafts for the rim when no alternative is available.

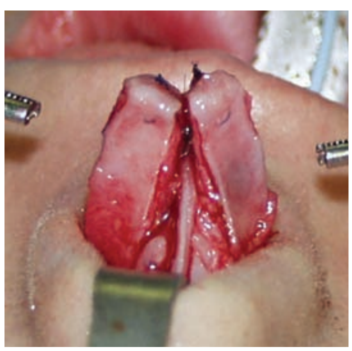
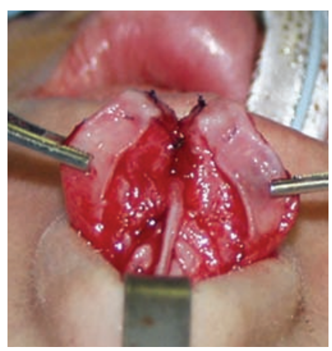
A hemitransdomal suture narrows the dome but everts the lateral crus, thereby minimizing rim concavity.




The lateral crus suture has been an extremely helpful suture technique. It is a horizontal mattress suture placed at the most convex part of the lateral crus. It flattens and stiffens the lateral crus, thereby diminishing the convexity and bulbosity of the tip. More than one such suture may be needed along the course of the lateral crus. Particular attention should be paid to the posterior (lateral) end, where the lateral crus often dips downward and becomes convex. This is a good location for a lateral crus suture.

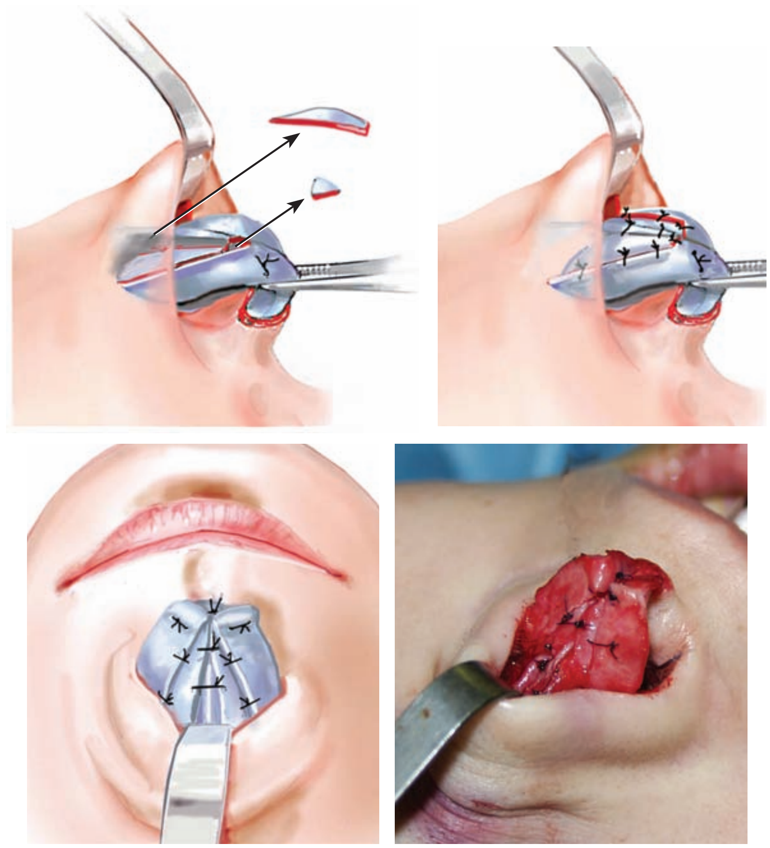
A lateral crus suture is a horizontal mattress suture that flattens and stiffens the lateral crus, removing nasal tip bulbosity.

Supratip-plasty

Persistent or recurrent broadening of the nasal tip is an often-neglected postoperative tip problem. A slightly wide tip (thought to be caused by edema) can look reasonable in the early postoperative period, but it often does not improve with time and can worsen. This complication is not discussed very often. I believe that edema can cause the lateral crura to separate, even after their convexities have been improved. This problem can occur if the lateral crura are not secured. Procedures that maintain nasal tip width include a lateral crural spanning suture, an alar spreader graft, and supratip-plasty techniques described by Regalado-Briz.[38,39]

A supratip-plasty minimizes postoperative nasal tip widening with a completely cartilaginous inflexible supratip. The lateral crus is preserved as an island, reduced in size, and secured to the dorsal septum.



Regalado-Briz[39] used sutures to recontour the supratip cartilage (the cephalic part of the lateral crus), without resection or a void between the lateral crus and septum. Baruffaldi Preis et al[40] suggested that the cephalic part of the lateral crus should be reduced in size and maintained. In our application of the supratip-plasty concept, my colleagues and I retain the cephalic part of the lateral crus as an island. (This is typically discarded.) Furthermore, it is reduced in size to fit the space between the lateral crus and dorsal septum and then sutured to the dorsal septum.

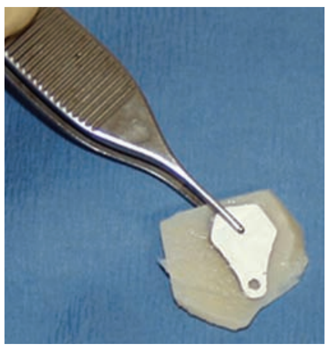
The result is a completely cartilaginous supratip region that is inflexible and not likely to widen during the postoperative period.

Tip Grafting

Tip grafting is a concept introduced by several surgeons, notably Sheen and Peck. My approach to tip grafting over the years has been to use it when (1) suture tip-plasty techniques cannot provide a normal tip and (2) complete projection cannot be obtained with columellar struts. Consequently, I use them commonly in secondary rhinoplasty and in primary cases with marked tip deficiency such as an Asian nose. An important feature is the use of one or more support grafts deep

to the tip graft. This is done for several reasons: (1) to set and stabilize an appropriate angle of the tip graft (the columellar-lobular angle), (2) to provide more tip augmentation rather than place multiple tip grafts, and (3) to fill dead space that tends to be present between the tip graft and the dorsal septum. Cartilage that is otherwise unusable works well as support graft. Good-quality cartilage can be preserved for other purposes.

Tip grafting is essential when suture tip-plasty is not sufficient and columellar struts cannot provide complete projection. A support graft is placed deep to the tip graft. This augments and positions the graft, and along with small grafts on the sides, helps to prevent visible edges.



Tip grafting can be frustrating if the graft is inadvertently cut too small and a larger piece is not available. Sizers can help to prevent this problem. A sizer is placed on the donor cartilage, and the graft is cut in cookie-cutter fashion before the final graft is placed on the tip.

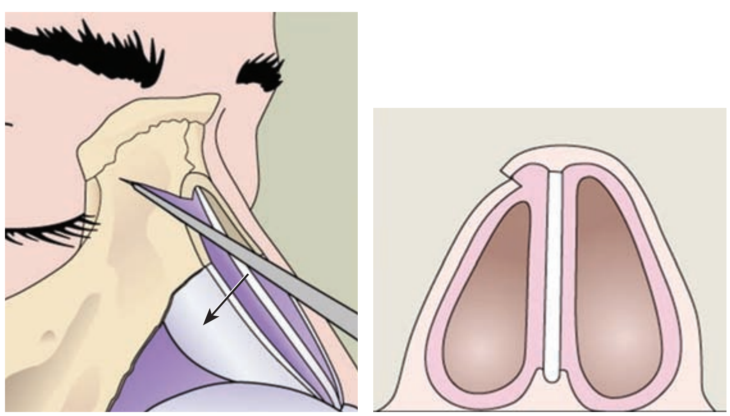
Tip graft visibility is a frequent complaint. To drastically reduce the risk of visibility, the graft edges are feathered and dead spaces around the graft are filled with small cartilage grafts. The support graft serves this function at the cephalic end. However, small grafts may be needed in the facet region on either side of a tip graft. A tip graft that projects like a tent pole will cause a problem in all patients except those with very thick skin. In patients with very thin skin, a single layer of temporalis fascia will soften the edges of a tip graft.

According to the surgical philosophy of tip grafting, a tip graft is only one component of cartilage applied to the tip to re-create the frontal aspect for definition or projection. However, the cephalic side and lateral sides should not be ignored. The surgery involves more than the addition of a tip graft; a new tip is created that ideally has the same shape as a tip after suture tip-plasty.

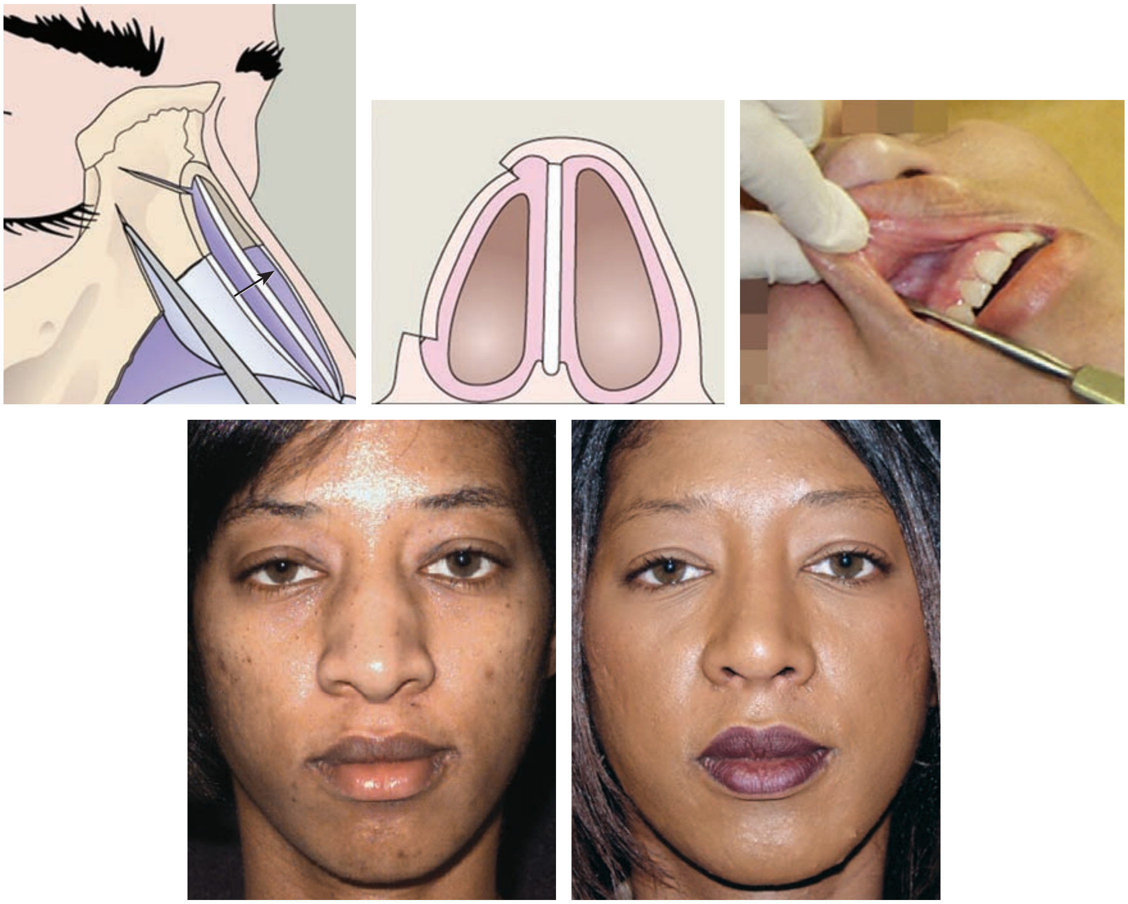
Osteotomies

For the purposes of nasal bone reduction, the nose is classified into one of the following types:

Type I: Broad nasal base
Type II: Broad dorsum and nasal base
Type III: Broad dorsum only (This is seen occasionally after a lateral osteotomy is performed at the first surgery, leaving the wide dorsum untouched and resulting in nasal bones that are vertical and parallel to one another.)



To correct a broad nasal dorsum, a medial oblique osteotomy is performed. Surprisingly this osteotomy alone can reduce the dorsal width if the osteotome is pried once it is deep in the bone. To correct a broad nasal base, a medial osteotomy usually is performed with an osteotomy.

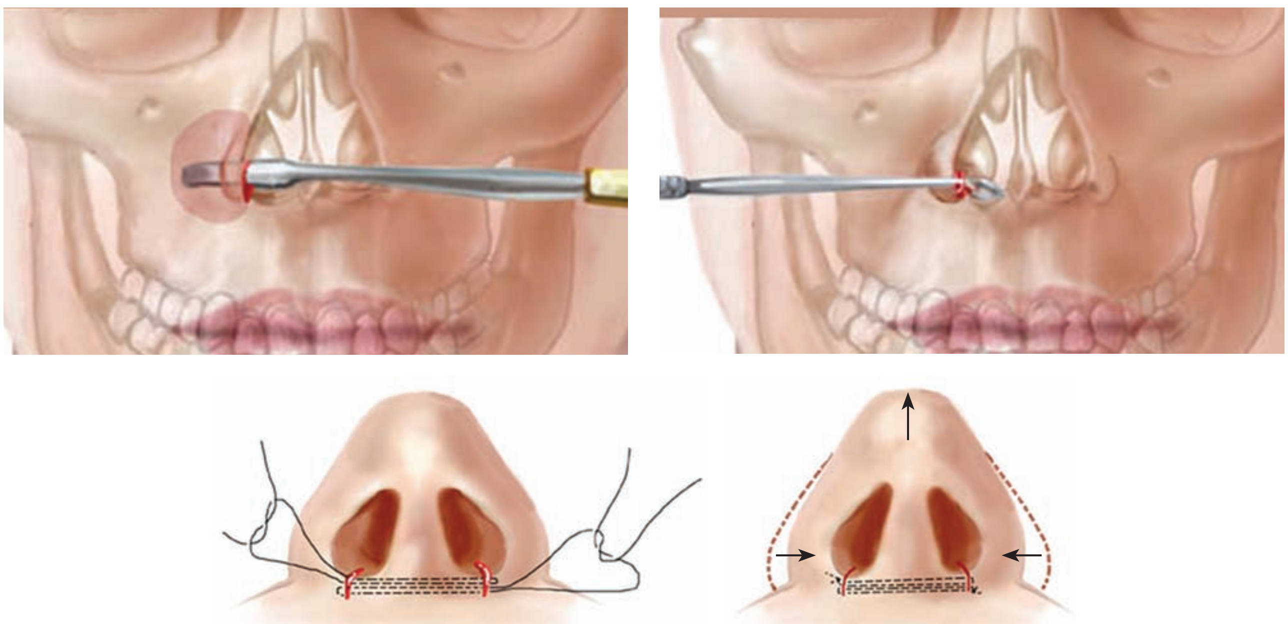


A wide nasal base is corrected with a low-to-low osteotomy by way of the buccal sulcus. If the incision in the buccal sulcus is large enough, the piriform fossa and the location where bone cutting should begin are seen easily. The result of both of these osteotomies is a triangular-shaped shell of nasal bone that is easy to manipulate into the appropriate position with minimal digital pressure with essentially no bleeding. To minimize bleeding from osteotomies and to ensure hemostasis in general, I make osteotomies less than 3 mm wide, per the recommendation of Gryskiewicz and Gryskiewicz,[41] and I routinely give desmopressin (DDAVP) at least 1 μg/kg intravenously over 30 minutes. Berkowitz[1] routinely gives 3 μg/kg intravenously, which is the dose ordinarily used for conditions such as von Willebrand's disease. This slightly hypercoagulable state has been extraordinarily helpful, without apparent complications of coagulation or thrombosis.

Nasal bone width is decreased easily by a medial oblique osteotomy to reduce dorsal width and a low-to-low lateral osteotomy to reduce nasal base width. When these two osteotomies are performed, the nasal bone is essentially a triangular bone shell attached cephalically that is easily manipulated into most positions.

Nasal Base Reduction

The creation of a natural-looking and narrow nasal base is one of the most frustrating problems in treating ethnic noses. Reduction of the alar base–sill usually does not reduce the overall width sufficiently. Consequently, over the years many surgeons[42-49] have recommended a cinch procedure in which the entire nose is narrowed with a large interalar suture or two. The effect is similar to that of squeezing the alae together with fingers. The main problem with this technique is recurrence.



2-0 or 3-0 PDS or nylon

My approach is to perform a substantial alar release through the buccal sulcus to reduce the lateral tension on the alae when they are pulled together and held in the medial position by large transverse (interalar) sutures. This procedure is performed with or without alar base excision. It is often carried out as a separate, secondary procedure after a prior alar base resection did not reduce the overall nasal base width completely. Successful use of interalar sutures depends on several factors. A large needle is used to traverse the entire nasal base. A very deep and substantial bite of soft tissue is taken in the alar crease wound (usually muscle). Slight overcorrection is performed. The competency of the result is tested by spreading apart the nostrils with the handles of forceps to confirm that the width appears satisfactory under lateral tension. Some recurrence is common postoperatively, even after all of these steps are performed.

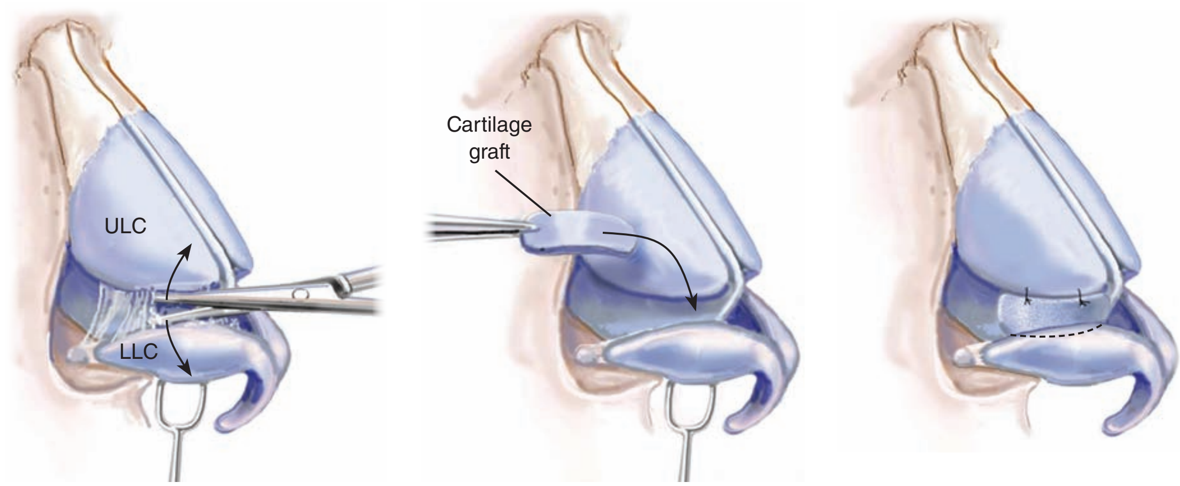
To reduce the overall width of the nasal base (other than by alar-sill resection), the alae can be released with a buccal sulcus approach to reduce tension through medialization. Interalar sutures then maintain a narrower nasal base width.

The results of overall nasal base reduction are far better today than they were years ago before these extra measures were taken.

Intercartilaginous Graft

One of the truly great innovations in rhinoplasty is the lateral crural strut described by Gunter, which I commonly use. However, some patients' alar retraction is so severe that a bit more is needed. I have found it necessary in these cases to insert an intercartilaginous graft between the upper lateral cartilage and the lower lateral cartilage.

The potential for alar retraction can be minimized by preservation of the cephalic lateral crus that is commonly discarded to reduce tip bulbosity.



This is done with the following steps. First, the vestibular lining is hyperinfiltrated. The cartilaginous gap is then spread between the ULC and LLC. A graft of septal origin is inserted, if possible. The caudal end of the graft is inserted deep to the first millimeter or two of the lateral crus. The graft is sutured to the ULC in end-to-end fashion.

EARLY POSTOPERATIVE PROBLEMS

A gross problem such as an unusually overrotated nose or a crooked nose that is supposed to be straight can be immediately evident when the splint is removed. This occurs occasionally more often in the early years of a surgeon's practice. These types of problems do not resolve, and waiting 6 or more months before surgical correction may cause an incredible amount of anger on the patient's part and frustration for the surgeon. Under such circumstances it is best in my experience (and others have previously recommended it) to return the patient to the operating room immediately. Until day 10, the tissues are not very sealed, and intervention does not cause much swelling or induration. It is not the time for a complete secondary surgery or revision. At this point, only gross abnormalities that are not likely to improve with time should be repaired.

In the unlikely event that the nose is grossly abnormal (for example, crooked or severely overrotated) after splint removal, the patient is returned to the operating room immediately.

A problem commonly occurs very early postoperatively, when the nasal splint is removed on day 5 to 7 after surgery. The patient looks in the mirror and is quiet. This silence should not be interpreted as happiness with the result. It is more likely a sign of respect for the surgeon and of not wanting to vocalize a complaint.

The problem is commonly nasal tip edema, which is normal but upsetting for patients who are not expecting it. Patients have a hard time convincing themselves that the result after splint removal is not the final result.

At the time of splint removal, patients may be quiet or anxious about an apparently large nasal tip. Immediate taping restores confidence. Patients are allowed to remove the tape after 4 days.

I take the opportunity to apply ½-inch, flesh-colored tape to the tip of the nose, explaining to the patient that the tape will help to control swelling (Belek and Gruber[50]). Indeed, it helps to prevent swelling from becoming worse while the patient adjusts to the result. Most patients are much happier as soon as the tape is applied. They are allowed to remove it after 4 days.

Edema that is persistent and resolves slowly is treated with a different type of tape (Blenderm; 3M, St. Paul, MN). It is a very elastic, stretchy, ½-inch tape that is applied in the same manner as the flesh-colored tape. However, patients are asked to apply it in the evening between dinner and bedtime if they do not have social activities to attend. It controls edema and induration to a very significant degree and involves patients in their own care—a very important principle. The need for corticosteroid injections to control tip edema decreased considerably after I started to use this type of taping procedure.

Elastic taping during the first few months postoperatively is often needed and is very helpful to reduce edema. The need for corticosteroid injections for the same purpose has diminished as a result.

CONCLUSION

I find it best to treat patients with the same respect, concern, and care I would give to my own family members and friends. As a result, decision-making is easier, and I tend not to rush surgeries. If, however, problems occur (and they are more likely to occur with rhinoplasty surgery than with many other types of surgery), I am quick to recruit the opinion of a trusted colleague when I have doubts about the best treatment. For patients who are unhappy with my recommendations, I am equally quick to suggest that they seek a second opinion. The fundamental goal is the health and welfare of every patient. This is what prompts me to listen to patients, seek the best treatment options, and follow through with lingering problems until the best possible result (especially a patient's happiness) is achieved. This can require a lot of time, effort, and energy—and frequently does. The result is what makes rhinoplasty special.

It is best to get a second opinion for your patient before the patient gets a second opinion of you.

KEY POINTS

- Analysis and morphing with any one of the computer imaging systems are extremely helpful. They enhance communication and offer an opportunity for mock surgery.
- Airway obstruction from turbinate hypertrophy and malposition of the bony septum responds extremely well to *septoturbinotomy,* which is a simple, safe, noninvasive means of opening the airway.

- Expiratory obstruction is generally caused by a problem with the septum and/or turbinates. Valve problems affect inspiratory flow.
- Spreader flaps in primary rhinoplasty can be used to rebuild the internal valves and preserve the aesthetic appearance of the middle third of the nose, thereby preserving donor cartilage that would have to be used for spreader grafts otherwise.
- Ear cartilage can be exceptional donor material if it is straightened with horizontal mattress sutures. The concha cymba can be split down the middle and straightened with horizontal mattress sutures to create a good columellar strut or lateral crural strut.
- A hemitransdomal suture narrows the dome but everts the lateral crus, thereby minimizing rim concavity.
- A lateral crus suture is a horizontal mattress suture that flattens and stiffens the lateral crus, removing nasal tip bulbosity.
- A supratip-plasty minimizes postoperative nasal tip widening with a completely cartilaginous inflexible supratip. The lateral crus is preserved as an island, reduced in size, and secured to the dorsal septum.
- Tip grafting is essential when suture tip-plasty is not sufficient and columellar struts cannot provide complete projection. A support graft is placed deep to the tip graft. This augments and positions the graft, and along with small grafts on the sides, helps to prevent visible edges.
- Nasal bone width is decreased easily by a medial oblique osteotomy to reduce dorsal width and a low-to-low lateral osteotomy to reduce nasal base width. When these two osteotomies are performed, the nasal bone is essentially a triangular bone shell attached cephalically that is easily manipulated into most positions.
- To reduce the overall width of the nasal base (other than by alar-sill resection), the alae can be released with a buccal sulcus approach to reduce tension through medialization. Interalar sutures then maintain a narrower nasal base width.
- The potential for alar retraction can be minimized by preserving the cephalic lateral crus that is commonly discarded to reduce tip bulbosity.
- In the unlikely event that the nose is grossly abnormal (for example, crooked or severely overrotated) after splint removal, the patient is returned to the operating room immediately.
- At the time of splint removal, patients may be quiet or anxious about an apparently large nasal tip. Immediate taping restores confidence. Patients are allowed to remove the tape after 4 days.
- Elastic taping during the first few months postoperatively is often needed and is very helpful to reduce edema. The need for corticosteroid injections for the same purpose has diminished as a result.
- It is best to get a second opinion for your patient before the patient gets a second opinion of you.

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Constantian's Approach

Mark B. Constantian

The nasal skeleton imparts half of the shape of the nose, but the soft tissue skin sleeve imparts the other half—if it didn't, there would be no such thing as a supratip deformity. The ability to assess the support, shape, and nuance of the nasal surface with the skin sleeve in its resting tension and position is the primary advantage of closed rhinoplasty, which is why I use it exclusively.

I organize my preoperative thoughts, decipher the intraoperative changes, and make technical decisions based largely on surface indicators; that is, what the soft tissues show before, during, and after surgery. In contrast, surgeons who favor the open approach base the majority of their preoperative and intraoperative decisions on an analysis of nasal skeletal structure. Certainly I need to consider skeletal anatomy, just as open rhinoplasty surgeons need to consider the soft tissues, but my focus is different. It is impossible to understand the logic of closed rhinoplasty if the surgeon believes that his or her primary goal is to see the skeleton perfectly. It is not. The surgeon's objective is to achieve the patient's aesthetic and functional goals as accurately as possible without introducing new deformities.

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The sad truth is that the most common indication for revision rhinoplasty, based on my series of 150 consecutive patients, was an iatrogenic deformity (89% of patients in that series).[1] The surgeon must be constantly aware of this fact as he or she selects any rhinoplasty technique and performs it.

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Therefore it follows that the nasal skeleton is actually irrelevant, except insofar as it influences surface contour or airway. Managing the skeleton is only half of the surgeon's job.

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Supratip deformity, alar-nostril distortion, and columellar deformities are shown in a 23-year-old woman after three open rhinoplasties; the original deformity was probably a forme fruste midfacial cleft. The drawing of the surgical correction outlines the skin/conchal cartilage composite graft used to reduce the right alar rim height; the left alar rim was excised.

The patient is shown 30 months after costal cartilage, maxillary, dorsal, right lateral wall, and tip augmentation. Despite deliberate columellar thinning and marginal excision, much of the original columellar deformity remains. Thirty-two months postoperatively, geometric mean nasal airflow had increased 10.8 times.

THE LOGIC OF THE CLOSED APPROACH

I take a laissez-faire stance concerning rhinoplasty technique, believing that surgeons should use whatever method produces their best results. The open approach does allow binocular vision, fixation of grafts, and the ability to suture modify the skeleton. However, arguments can also be made to support the closed approach, as follows:

1. In many ways, closed rhinoplasty is easier: less dissection is required, and what is most important, the surgeon always has a view of the undisturbed nasal surface.

2. Because there is less intraoperative soft tissue manipulation and the dorsal and tip skin never leave their preoperative positions, the surgeon has the ability to control tip contours more accurately (for example, producing a more or less angular tip to suit the patient's aesthetic). Therefore the closed approach provides the opportunity for fine tuning that is difficult to achieve with the open approach.
3. Some tip techniques (for example, multiple crushed tip grafts) are easier to perform in closed pockets than in an open tip, where usually each graft must be sutured into position.
4. There is little or no need to suture stabilize grafts in closed rhinoplasty, because surgical dissection proceeds only far enough to give access to the skeleton that requires augmentation or reduction; the soft tissue pocket immobilizes the grafts.
5. Fewer routine open rhinoplasty grafts are required. For example, because the medial crura are never destabilized by separation from the adherent columellar skin, there is no consequent need for columellar strut grafts. In secondary cases, where donor sites are often in short supply, the requirement for less graft is an advantage.
6. Fewer variables reduce postoperative problems. Because it is much harder to suture-modify the nasal cartilages, there are no sutures to absorb or be overcome by inherent cartilage stresses, and there is no foreign material left behind at the end of the procedure.
7. The surgeon cannot get into as much trouble. Extensive dissection is more difficult through the closed approach because access is limited. Fewer techniques can be performed through the closed approach compared with the open approach (for example, tip-suturing possibilities are not limitless, and columellar skin cannot be resected to decrease tip projection). Therefore postoperative variables are also limited.
8. There is ample evidence that patients who have had open rhinoplasties have a different spectrum and a higher prevalence of postoperative deformities; some, like columellar widening or notching, or significant alar rim and alar cartilage distortions, are almost unique to the open approach.[2] Many espoused open rhinoplasty techniques are demanding on the surgeon and should be selected and approached with caution.
9. The scar does matter. Most surgeons are not experts in rhinoplasty. The surgeon evaluating an approach cannot presume that the published results of experts (operating by any method) will resemble their own everyday results any more than they resemble the everyday results of the experts. Poor scars after open rhinoplasty are not uncommon. The columella often becomes wider or twisted, and the scar can become stepped, notched, or depressed. It is extremely difficult to widen the columella by performing a closed rhinoplasty, because columellar strut grafts are unnecessary. Certainly the likelihood of those misadventures depends on

how much cautery is used, and how the soft tissues are handled, retracted, and repaired. Nevertheless, these complications also depend on the nature of the soft tissues themselves, which are not under the surgeon's control. It is always better to avoid a surface scar if possible.

Arguments can be made against each of these points by surgeons who favor the open approach. My remarks should be taken as an explanation of why I believe that the closed approach, for all of its presumed (but inaccurate) difficulty and limited access, has inherent advantages, and not as reasons to oppose open rhinoplasty.

Closed rhinoplasty does not mean blind rhinoplasty.

I reduce the cartilaginous dorsum, reposition the lateral crura or modify the alar cartilages, perform septoplasty, and place spreader and dorsal grafts all under direct vision. Only reduction of the bony vault and some aspects of tip graft placement must be performed with limited access. In those cases, decisions are made based on surface contours, not actual skeletal size or structure; therefore the limited binocular vision is unimportant.

BACKGROUND: WHY RHINOPLASTY IS DIFFICULT

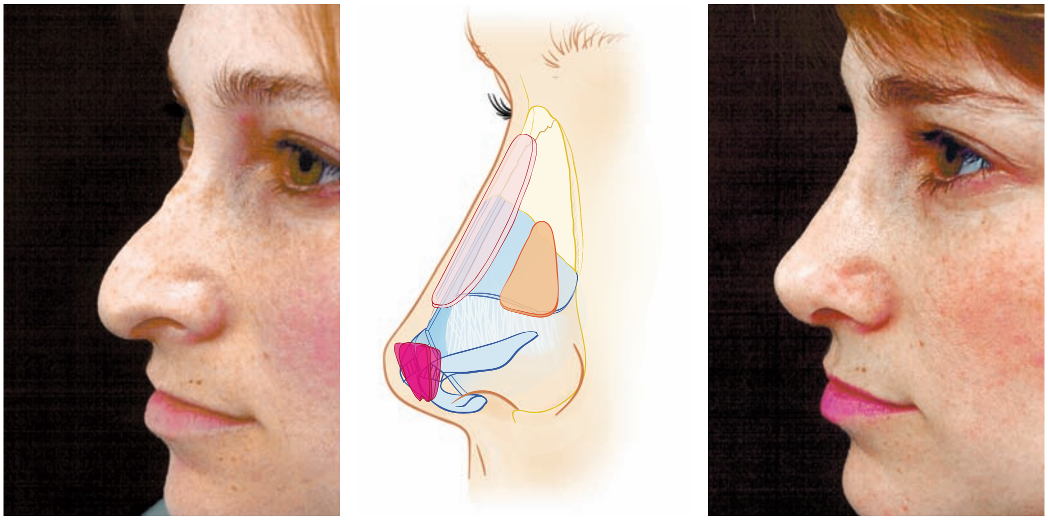
False Assumptions of the Reduction Model

The aphorism that rhinoplasty is the hardest plastic surgical operation is usually attributed to several causes: limited access and visibility through a closed approach, complex anatomy, technical difficulty, and/or unpredictable and idiosyncratic nasal healing.

It has been my contention over the years that rhinoplasty is difficult primarily because the traditional reduction model is insufficiently complex.

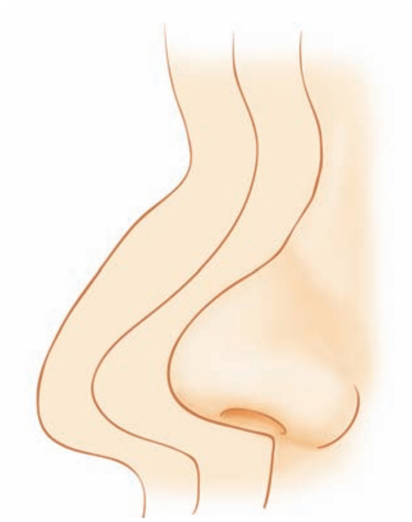
Until the new paradigm introduced by Sheen[3] began to raise questions about it, aesthetic rhinoplasty was perceived as a reduction operation based on the concept that good results were created by reducing the preoperative nasal framework, following which the nasal soft tissues would contract around the new skeleton and reveal its improved shape. If preoperatively a nose did not have a good shape, it was because most or all parts were too large: the nose was big, the tip wide, the bones wide, the bridge high, the nostrils flaring, and/or the whole nose was big. Although reduction rhinoplasty did sometimes work, in many cases it did not—either compromising the airway or yielding a poor shape, or both. The explanation for these failures derives from two false assumptions underlying the traditional model, neither of which is true.

False Assumption Number One: The Nasal Soft Tissue Cover Has the Infinite Ability to Contract to the Shape of the Underlying Skeleton The entire reduction rhinoplasty result depends on this assumption. However, if it were true, supratip deformity would never occur and augmentation would not correct it. (Remember that traditionally one cause of supratip deformity was attributed to inadequate resection of the dorsal septal edge.)

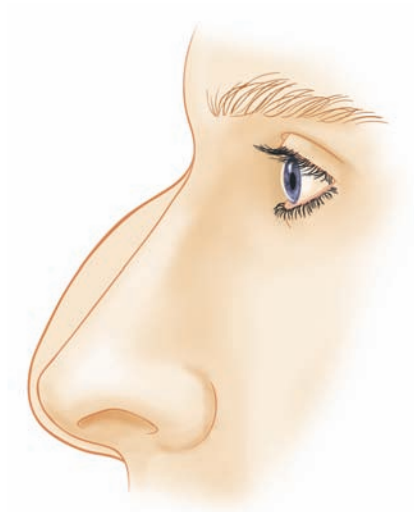


This secondary rhinoplasty patient presented with obstruction at the internal and external valves. Reconstruction entailed nasal shortening and dorsal, lateral wall, and tip grafts. She is shown 17 months postoperatively.

The nasal skin sleeve does contract according to its own quality, thickness, and preoperative distribution, not necessarily to the shape of the surgically reduced skeleton. The vectors of skin sleeve contraction are related to, but independent of, the volume and contour of the underlying skeleton, the end stage of which is a pyramidal contraction of the upper nose and supratip deformity in the lower nose. These structural interdependences are not only predictable but also necessary for accurate preoperative planning, interpretation of intraoperative nasal appearance, postoperative success, and correction of secondary deformities.[4-7]



The soft tissue contraction from the preoperative profile *(left),* immediate postoperative profile *(center),* and 1 year postoperative profile *(right)* is demonstrated.



False Assumption Number Two: Alterations in the Nasal Skeleton Produce Purely Regional Changes The classic application of this assumption is the common preoperative plan in which a line is drawn from the root to the most projecting point of the tip on the patient's preoperative lateral photograph. Presumably, skeletal resection anterior to that line will produce a straight profile: dorsal resection affects only dorsal height, and tip reduction affects only tip shape. Changes in the nasal skeleton, however, are not independent but interdependent.[2] Nasal bridge resection affects nasal width and length, apparent nasal base size, middle vault support, nostril shape, and columellar position. Lower lateral cartilage reduction affects tip support and projection, nasal length, alar rim contour, and external valvular support.

Far from being independent, nasal regions are interdependent, and these structural interdependences are not only predictable but also necessary for accurate preoperative planning, interpretation of intraoperative nasal appearance, postoperative success, and correction of secondary deformities.

WHAT MAKES RHINOPLASTY DIFFERENT?

Unlike an operation that can be portrayed step by step in atlases, rhinoplasty is difficult to learn for several reasons. The most common explanation for that difficulty is the limited access and visibility afforded by the operation, particularly in the closed approach. The following reasons are even more important.

One paramount reason that rhinoplasty is difficult to learn is that it is a feedback operation that cannot be premeasured and premarked. The surgeon must recognize the changing intraoperative appearance and respond accordingly. Rhinoplasty is a right-brain operation. I know of no better way to learn than by taking sequential photographs during the operation and studying them after surgery.

For this reason, rhinoplasty has more in common with Millard's rotation-advancement cleft lip repair than with the Tennison-Randall triangular flap method. Rhinoplasty is a cut-as-you-go procedure. Moreover, rhinoplasty feedback is nonlinear in the sense that an alteration of one area often produces effects distant from the part modified because of the interdependence of nasal structures. These effects are not idiosyncratic, but the surgeon must learn to recognize them and then make secondary adjustments as needed. For example, dorsal reduction often shortens the nose and changes the relationship of the columella to the alar rim. Consequently, a nose that has a satisfactory preoperative nasolabial angle may require an alteration in the caudal septum simply because of the effect of the dorsal resection. There are other more critical structural interrelationships that manifest themselves intraoperatively that the surgeon must understand to proceed successfully. The most important of these will be outlined during the surgical sequence presented later in the chapter.

INDICATIONS AND CONTRAINDICATIONS

I do not believe that there are any contraindications to closed primary rhinoplasty. In fact, the more difficult the deformity and the more difficult the case, the stronger the argument that can be made for limiting access, limiting incisions, and minimizing morbidity.

PLANNING THE RHINOPLASTY

Basic Nasal Aesthetics

Before planning any surgery, the surgeon must know where he or she is headed. The following discussion of aesthetics may seem naive and overly simplified, but this originates in my views about practical rhinoplasty. Despite the fact that countless sophisticated parameters have been defined, the rhinoplasty surgeon is more limited than he or she may admit or wish.

Skin volume and thickness, anatomic strength and structure, and the bony and soft tissue elements of the rest of the face have all been predetermined. Unless the surgeon is planning a major craniofacial rearrangement, it is impractical to create nasal aesthetics that are defined by artistic ideals, because the surgeon does not really control any feature but the nose.

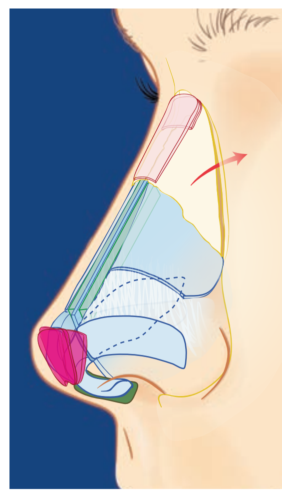
For example, rigid adherence to the concept that the width of the alar base should correspond to the intercanthal distance may compel the surgeon to narrow an alar base in a nose with a wide, noncontractile tip lobule, thereby distorting the lower nose. This presumably universal Renaissance aesthetic principle actually only occurs in a minority of white individuals, and even less commonly in blacks or Asians. Instead, it is safest to define most nasal aesthetics in terms of the balance and proportion of one nasal part to another, which is all the surgeon really has the chance of changing.

On frontal view, the upper nose (nasal root) should be narrower than the lower nose (nasal base), and symmetrical, confluent, divergent lines should connect the two. On oblique view, there should be no regional discontinuities, the supratip should be flat, and the mass of the tip lobule should fall below the levels of the peaks of the lower lateral cartilage domes. On lateral and oblique views, nasal length and base size should balance each other. In general, the nasal root should begin at the level of the upper lash margin but this parameter, too, must relate to the size of the nasal base. If the nasal base is short, a nasal root that begins at midpupillary level may be entirely adequate, whereas treatment of the patient with a large nasal base often requires elevating the root to the upper lash to maximize nasal balance. The airway should be patent and stable on forced inspiration.

Beyond these basic concepts, further details depend on the patient's skeletal framework, soft tissue cover, and aesthetic goals. Rhinoplasty offers the possibility of individualizing a result as much as or more than any other aesthetic procedure, and the closed approach is often the key to doing so.[8]

Preoperative

1 year postoperatively



5 years postoperatively

This patient had bilateral, flat, malpositioned lateral crura and inadequate tip projection. She is shown 1 year and 5 years postoperatively after resection and relocation of the lateral crura, minimal dorsal reduction, nasal shortening, and radix, spreader, and tip grafts. Note the apparent diminution in nasal base size achieved by tip rotation and elevation of the radix. Postoperative airflow doubled over preoperative measurements.

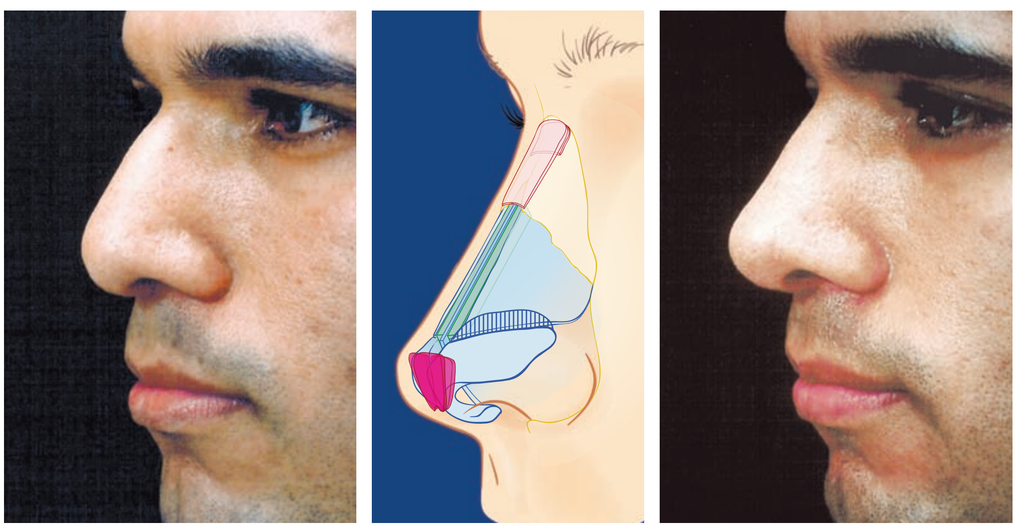
Parameters of Rhinoplasty Planning

I use three right-brain, soft tissue parameters to form my rhinoplasty plan for both primary and secondary cases, regardless of whether the skeleton influences surface contours or not[5]: skin thickness, skin distribution, and the contour of the tip lobule.

Skin Thickness and Distribution

Although it may be intuitively obvious that only skin thickness affects rhinoplasty strategy, skin distribution is a factor as well.

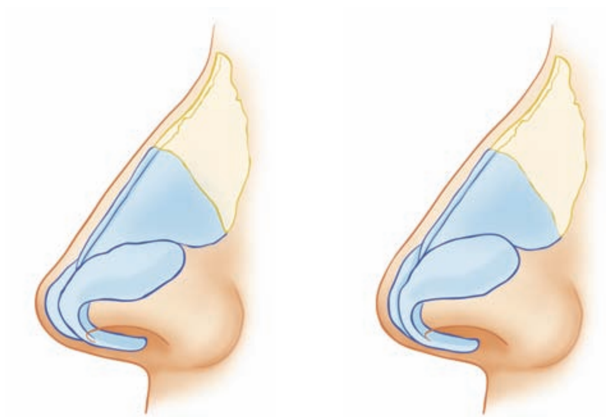
Because skin contractility is limited, significant skeletal reduction beneath a large nasal base will not produce a small, attractive nasal base but rather a distorted (but still large), nasal base.[8-10] Therefore skin quality affects reduction and augmentation alike. Thicker skin will contract less, and also requires more substantial grafts to effect a surface change. Thinner tissues allow greater reduction but will require softer, more carefully constructed grafts to avoid surface distortions.



This patient had thick skin, inadequate tip projection, and a high dorsum. His skin thickness affected the strategy. He is shown 2 years postoperatively.

Tip Lobular Contour

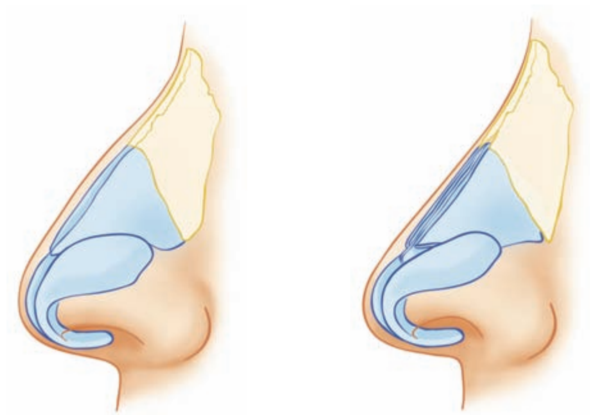
Ideal tip aesthetics, in their simplest terms, require a point of greatest projection that is high on the tip lobule, a flat supratip, and a tip lobular mass that falls below the point of greatest projection. In contrast, a poorly shaped tip lobule has a point of greatest projection that falls low on the lobule itself, a convex supratip, and a tip lobular mass that lies cephalad to the point of greatest projection. These characteristics are simple and easy to recognize.



The morphologic differences between tips that require grafting (or some method of increased tip projection) and those that do not are shown. In a well-shaped tip lobule *(left),* the supratip is flat and the mass of the lobule falls caudal to the level of the peaks of the lower lateral cartilage domes. In a poorly shaped tip lobule *(right),* the supratip is convex and the mass of the tip lobule lies cephalad to the level of the peaks of the lower lateral cartilage domes.

Simple lower lateral cartilage reduction cannot convert a poorly shaped lobule into a well-shaped lobule.

If the point of greatest projection (the so-called tip-defining point) is low, the relevant anatomy is a short middle crus.[11,12] To transform a poorly shaped lobule into a well-shaped lobule, the surgeon must, in effect, lengthen the middle crural segment. Numerous suture methods have been described, but because the poorly shaped lobule has a deficit of middle crural cartilage, I believe that the most direct and logical solution is tip grafting.



The effect of skeletal reduction on a tip that requires augmentation is shown. The tip lobular mass only shifts further cephalad; the peaks of the lower lateral cartilage domes have not been raised. Note the effect of dorsal reduction on the apparent size of the nasal base.

The Balance Between Nasal Base Size and Bridge Height

Dorsal reduction increases apparent nasal base size, a phenomenon that is visible not only in preoperative and postoperative photographs but also in the operating room. The reduction of apparent nasal base size by raising the height or length of the bridge is perhaps the most powerful illusion in rhinoplasty. This maneuver is most practically applied with patients who believe that their preoperative nasal bases are too large, most commonly expressed by the complaint, “My tip sticks out too far.”

Dorsal reduction and augmentation profoundly affect the apparent size of the nasal base; the higher the nasal dorsum (and the longer the distance from root to tip), the smaller the nasal base will appear. The reverse is also true.

In these patients, reduction in nasal base size may be most effectively achieved by raising part or all of the dorsum, a paradoxical principle that most patients and many surgeons have to see to believe.

THE FOUR CRITICAL ANATOMIC VARIATIONS

A great deal about rhinoplasty can be learned by observing one's own and other surgeons' unsatisfactory results. I see approximately 200 secondary patients each year in consultation. The overwhelming majority of their postoperative deformities derive from only four common anatomic variations. Every secondary patient has at least one, and among the patients that I see, 80% have three or all four anatomic variants. If unrecognized by the primary surgeon, each variation yields unsatisfactory results in varying degrees of severity. The surgeon who recognizes these variants preoperatively and makes their management part of the surgical plan will not make a serious diagnostic error in his or her rhinoplasties.

These anatomic variants are best remembered in the following pairs: (1) low dorsum/low radix and inadequate tip projection, and (2) narrow middle vault and lateral crural cartilage malposition.

Low Dorsum/Low Radix and Inadequate Tip Projection

The low dorsum/low radix and inadequate tip projection control the patient's lateral view; the surgeon must be able to recognize and treat both to create a straight profile and optimal nasal balance.

Low Dorsum: All You Need to Know About Low Radix/Low Dorsum

Dorsal length and height, balanced against lower nasal size, determines the attractiveness of nasal proportion. Therefore low radix or low dorsum are most important in patients with thick skin (whose soft tissues may not shrink adequately), or in patients who complain about the projection and size of their lower nose (which often signals a proportion problem, not a dimension problem).

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This patient had malpositioned convex lateral crura and inadequate tip projection. She is shown 24 months after resection and relocation of the lateral crura, dorsal reduction, and radix, spreader, and tip grafts. Note the ablation of the alar wall hollows and the alteration in alar rim contour after lateral crural relocation. Postoperative nasal airflow increased four times over preoperative measurements.

The low dorsum/low radix begins caudal to the level of the upper lash margin with the patient's eyes in primary gaze, and in a recent review was present in 93% of secondary patients and 32% of primary patients.[10] The low radix first described by Sheen and Sheen.[2,12,13] is one of several primary causes of nasal imbalance. As discussed earlier, when the nasal root begins low, nasal length is shorter and nasal base size therefore appears larger. The way around this surgical dilemma is to raise the dorsum segmentally or entirely to balance the patient's nasal base. In thicker-skinned patients, the strategy is particularly attractive because it requires less soft tissue contraction.

Inadequate Tip Projection: All You Need to Know About Inadequate Tip Projection

Tip projection reflects cartilage strength, not skin volume. Adequate tip projection is necessary for a straight profile line.

Inadequate tip projection had been present in 80% of the secondary patients and 31% of the primary patients in two of my reported series.[2,12] Understanding tip projection is critical to creating a straight profile. because the tip must support itself, independent of dorsal height. That independence is signified by the term *adequate tip projection,* which I define through the relationship of the tip lobule to the anterior septal angle. The practical value of this definition lies in its ability to guide treatment: adequately projecting tips do not need increased support, whereas inadequately projecting tips do. It is important for the surgeon to recognize that *adequate tip projection signifies cartilage projection, not skin projection.* Therefore a patient may have a large nasal base but still have inadequate tip projection. An oversized, unbalanced lower nose does not mean that the patient has excessive tip projection. Skin volume and cartilage strength are different anatomic entities. Any definition of tip projection should allow the surgeon to distinguish between the two.[13]

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Narrow Middle Vault and Lateral Crural Malposition

Just as low dorsum/low radix and inadequate tip projection control the lateral view, narrow middle vault and alar cartilage malposition control the frontal view, and what is more important, affect the airway.[14,15]

Narrow Middle Vault: All You Need to Know About the Narrow Middle Vault

A narrow middle vault signals an internal valve that is already compromised. The middle vault narrows after cartilaginous roof resection, so hump removal can inadvertently worsen the airway.

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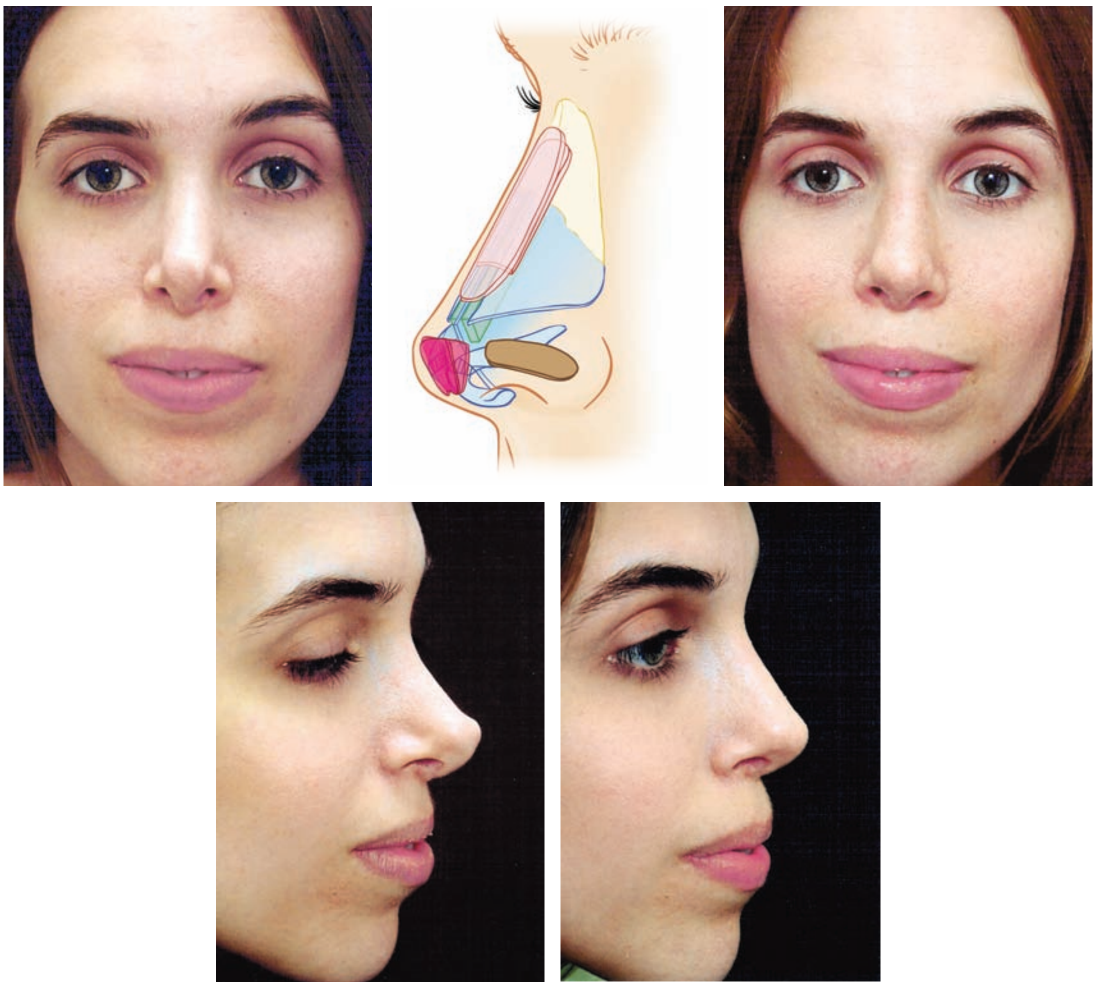

This woman presented with nostril, external valvular, and alar cartilage deformities after three open rhinoplasties. Her alar wall grooves were characteristic of preexisting lateral crural malposition. She is shown 22 months after resection of the deformed middle crura and prior lower lateral cartilage sutures; septal cartilage spreader, alar wall, dorsal, and tip grafts; and columellar scar revision.

The narrow middle vault was originally described by Sheen in conjunction with short nasal bones as a trait that places the patient at special risk for obstruction at the internal nasal valve.[10,11] Resection of even 2 mm of the middle vault roof during hump removal interrupts the intact preoperative arch that forms the up-

per cartilaginous vault.[16] This resection therefore ablates the stabilizing influence that braces each upper lateral cartilage, which can collapse toward the anterior septal edge and restrict airflow at the internal valve producing a characteristic inverted-V deformity.[14] Our rhinomanometric studies indicate that valvular obstruction is four times more common than pure septal obstruction in primary rhinoplasty patients, and twelve times more common in secondary patients, thereby emphasizing the role of valvular obstruction in the hierarchy of causes of airway obstruction.

Reconstruction of incompetent internal valves by either dorsal or spreader grafts doubles mean nasal airflow in most patients.[2,17]

Lateral Crural Malposition: All You Need to Know About Malposition

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Lateral crural malposition is characterized by lateral crura whose axes point toward the medial rather than the lateral canthi (the configuration typical in orthotopic lateral crura). This anatomic variation was first identified by Sheen[18] as an aesthetic deformity that produced a round or boxy tip lobule with characteristic parentheses on frontal view. At the time, malposition was believed to be a rare anatomic variant, but subsequent observation indicates that it is extremely common and present in approximately 50% of the population, although it occurs in approximately 80% of secondary rhinoplasty patients.[2,12,13] Malposition has an additional ramification that is not aesthetic: the abnormal position of the lateral crura cannot provide sufficient external valvular support. As a result, the great majority of primary or secondary rhinoplasty patients with malposition have incompetence, and therefore airway obstruction, at the external nasal valves.[11,16] Correction of external valvular incompetence doubles mean nasal airflow in most patients.[13]

Importance of the Anatomic Variants

In the previously referenced series, at least one of these anatomic variations was present in each of the 100 consecutive secondary rhinoplasty patients examined, two or more traits occurred in 99% of secondary patients, and three or all four of the traits occurred in 78% of the secondary patients.[10] In primary patients, 78% had two or more traits and 58% had three or all four traits. None of these anatomic variants is adequately treated by classical reduction rhinoplasty. Reduction of the low radix/low dorsum increases the preoperative nasal imbalance; reduction of inadequately projecting tip cartilages reduces their strength. Dorsal reduction of the narrow middle vault and reduction of malpositioned lateral crura impair internal and external valvular competence and obstruct the postoperative airway.

IMPLICATIONS OF PRIMARY RHINOPLASTY FOR THE AIRWAY

Until recently there was a surprising absence of consensus about whether rhinoplasty itself impaired airflow. Traditional teaching (still current among some surgeons) was that all patients must trade some airway size for improved appearance.

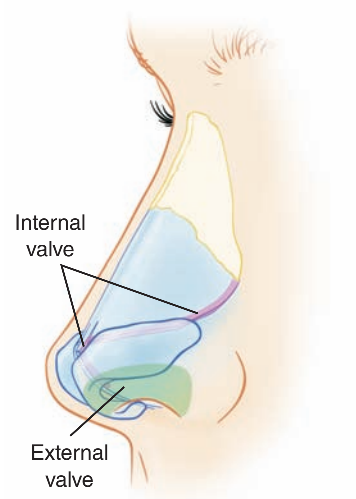
In 1991 I began systematic rhinomanometric measurements of consecutive primary and secondary rhinoplasty patients (excluding those with atopy or septal perforation) operated for airway obstruction. At the conclusion of the study in 2007, there were 600 completed studies.[16] To my knowledge, it is the largest airflow study of its kind ever published.[2,17] Approximately two thirds of these pa-

tients were women and one third men; 35% of the procedures were primary rhinoplasties and 65% were secondary rhinoplasties. The mean follow-up was 24 months. The conclusions may be summarized as follows:

1. Septoplasty alone produced no significant improvement in mean nasal airflow.
2. Internal valvular reconstruction doubled nasal airflow.
3. Spreader grafts and substantial dorsal grafts were equally effective in correcting internal valvular incompetence.
4. Correction of external valvular incompetence doubled airflow.[2,19]
5. Correction of obstruction at both valves was additive (three to four times preoperative values).
6. Septoplasty in addition to valvular reconstruction did not significantly improve nasal airflow over the results obtained by valvular reconstruction alone.
7. These results were produced without performing inferior turbinectomy.
8. Ninety percent of the secondary rhinoplasty patients had previously undergone an adequate septoplasty but were still obstructed.
9. Valvular reconstruction alone corrected the airway in 95% of patients after one procedure.
10. The improvement in primary rhinoplasty patients equaled or exceeded the improvement achieved in secondary rhinoplasty patients.

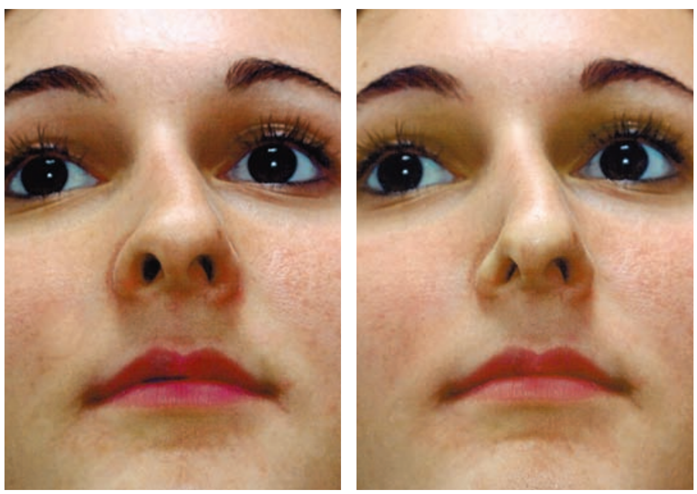
Several qualifying points should be noted. The data should not be taken to mean that septoplasty is valueless. However, although correction of septal deviation opens the airway on the obstructed side, septoplasty alone does not improve mean airflow of both sides. The nasal airway must be interpreted in terms of both of its sides—the septum on one side, and the lateral wall (containing the valves) on the other.

The internal nasal valve is composed of the caudal edges of the upper lateral cartilages at their articulation with the anterior septal edge; the external nasal valve is composed of the lateral crura of the lower lateral cartilages with their associated external and vestibular skin coverings. The watershed area between the valves occurs at the transverse portion of the alar crease.



Quiet inspiration Forced inspiration

Because normal air flows through the nose at 65 kilometers an hour, the size of any nasal airway depends on both the position and configuration of the septum as well as the stability and competence of the nasal sidewall under these significant transmural pressures.[2,20]



Quiet inspiration Forced inspiration

Symptoms on the side *contralateral* to the septal deviation can thus be explained, because greater transmural forces (on the more open side) collapse those valves first, blocking airflow first. In fact, approximately 50% of the patients in this study were more symptomatic on the side opposite the septal deviation.

Dorsal reduction sufficient to open the cartilaginous roof decreases internal valvular competence. Lateral crural reduction significant enough to create external valvular competence creates a second site of obstruction. Based on the observa-

tion that patients with combined obstructions triple or quadruple airflow post-operatively, *one could reasonably speculate that reduction rhinoplasty can decrease the preoperative airway by 75%.* In formulating a preoperative plan, the surgeon should never forget the preoperative airway or the anatomic variations relevant to its support.

INTRAOPERATIVE FEEDBACK AND TECHNIQUE IN PRIMARY RHINOPLASTY

As mentioned previously, rhinoplasty is difficult because the traditional reduction model is insufficiently complex and is based on two assumptions that may not always be true: (1) the nasal soft tissue cover has the infinite ability to contract to the shape of the underlying skeleton, and (2) alterations in the nasal skeleton produce purely regional changes. In addition, rhinoplasty is a feedback operation that cannot be premeasured and premarked. The surgeon must recognize the changing intraoperative appearance and respond accordingly. Nevertheless, a complete diagnosis can be made preoperatively from external and internal examination so that the surgeon can plan each step beforehand. The judgments that are made intraoperatively are thus quantitative rather than qualitative. A surgeon who believes that modern rhinoplasty is simply the old reduction model with grafts added is missing the point.

Rhinoplasty is not really an operation for the nasal skeleton. It is an operation for the skin surface and lining in the sense that the beauty of the external shape and the stability of the airway are the only real objectives. The skin sleeve alone constitutes 50% of the patient's result. Skeletal changes are a means to that end.

Skeletal structure is irrelevant except insofar as it determines surface contour or affects the airway. The structures are under a soft tissue cover that is contractile but within limits and with regional variations. For example, the upper nasal skin will contract to a greater degree and with simpler vectors than the lower nasal skin.

The goal of rhinoplasty, therefore, is not reduction. It is reduction and/or rearrangement to produce the best possible airway and the best possible shape with the greatest predictability without introducing new, iatrogenic deformities.

To that end, the soft tissues must be balanced against the skeleton at the conclusion of the procedure, and the skeletal parts should be balanced against each other. For example, the middle vault should be properly supported to protect the internal valves. Thus modern rhinoplasty is a combination of reduction and rearrangement to produce a nose that is attractive and equilibrated at the end of the procedure. The surgeon who controls the nasal equilibrium (between soft tissue and skeleton, and between one skeletal part and another) controls the postoperative result.

SURGICAL STRATEGIES

Rhinoplasty deformities are not limitless; they form patterns (see Chapter 38). The same is true of preoperative deformities. The good news is that the solutions can also follow patterns.

As a broad but accurate observation, most patients have either (1) a dorsal hump with inadequate tip projection or an undefined tip, or (2) a low dorsum relative to nasal base size, with or without adequate tip projection. Thus the two operative sequences that I use for most patients are to resect or reposition the deformity—that is, remove or reposition what is in excess (for example, reduce a dorsal hump or reposition cephalically rotated lateral crura); clear the airway and harvest graft material, and then either:

1. For a dorsal hump or imperfect tip, place radix, spreader, and tip grafts.
2. For a low dorsum and imperfect tip, place dorsal and tip grafts.

These two strategies, when thoughtfully applied in concert with the patient's aesthetic goals, will correct most rhinoplasty deformities. It can be seen in each drawing that accompanies the case studies in this chapter and in Chapter 38 that the surgical plan always follows one of those two patterns.

SURGICAL SEQUENCE

Operative Order

The usual operative order is to (1) remove deforming skeleton or reposition anatomic parts so that they function better, (2) harvest graft material, and (3) augment for airway and shape and to control the nasal equilibrium.

Steps in the Operative Sequence

As I describe each step of a typical primary rhinoplasty, I will mention the most important interrelationships that are evident at each step and why they occur. Many of these can only be observed in undisturbed soft tissues through the closed approach.

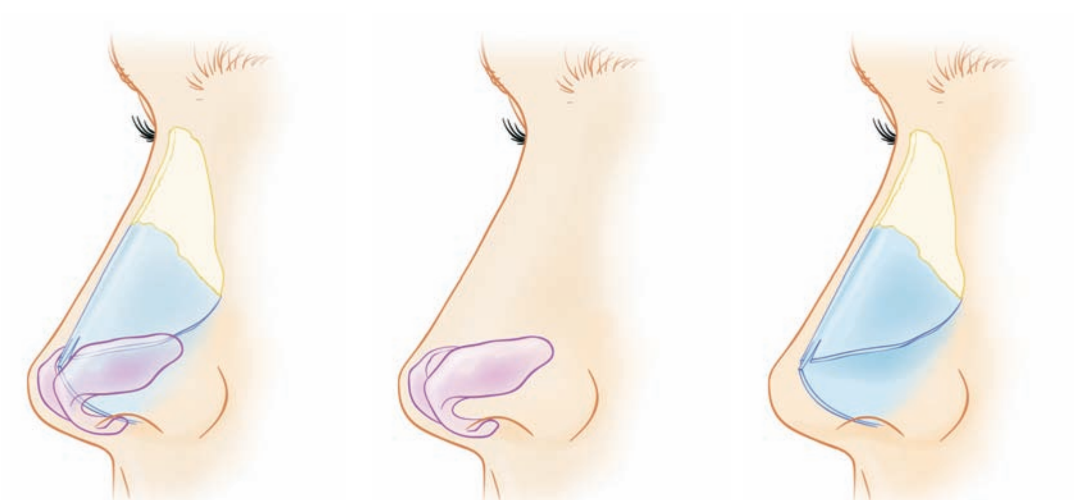
Anesthesia and Preparation

I perform all rhinoplasties with the patient under general endotracheal anesthesia, keeping the systolic pressure between 80 and 90 mm Hg, assuming no contraindications in the patient's medical condition; 1% lidocaine with epinephrine 1:100,000 is infiltrated along the nasal root, lateral walls, columella, across the maxillary arch, and into each alar lobule. The nasal vibrissae are shaved, and the nose is thoroughly cleansed internally. The surgeon should remember that the nasal lining is the real operative surface, and its preparation should be even more fastidious than skin preparation. I pack the nose with cocaine-soaked cotton, using no more than 160 mg of cocaine for each patient (safely below the 200 mg maximum allowable dosage).

Skeletonization

Skeletonization controls access to the underlying skeleton and influences movement of the skin sleeve. By limiting skeletonization appropriately, the surgeon can use the undisturbed soft tissues to immobilize cartilage grafts. If a nose requires significant shortening, the middle vault should be more widely skeletonized; otherwise, skeletonization is limited only to areas requiring skeletal reduction or augmentation.

Artifacts



The outer nasal layer *(center)* is composed of the lower lateral cartilages and the nasal skin; the inner nasal layer *(right)* contains everything else. Because the lower lateral cartilages are contained within the mobilized skin sleeve, surrounded by external and vestibular skin and lining, the lower lateral cartilages move as if they are external to the remaining nasal skeleton. Therefore skeletoni-

zation appears to shorten the nose, flatten the dorsum, move the radix more anteriorly, and lower the columella. The surgeon should be wary of these misleading signals and not be tempted to reduce the dorsum less or elevate the columella more than was planned.

Technical Details

In a primary rhinoplasty, I ordinarily skeletonize the nose through unilateral or bilateral intercartilaginous incisions, depending on the need for lower lateral cartilage modification. Unless the nose needs to be shortened, the skeletonizing incision can stop just past the septal angle; a complete transfixing incision is not routinely indicated. The middle vault is skeletonized using Joseph scissors, and the soft tissues are cleared from the bony vault using a broad Cottle periosteal elevator.

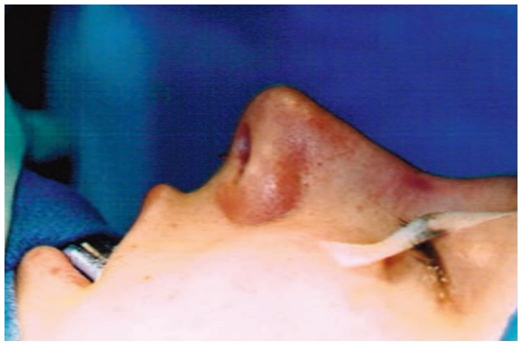
Dorsal Resection

A low radix is extremely common, but only if the surgeon considers the balance between the dorsum and the base: I raise the nasal root in at least 75% of primary rhinoplasties. The amount of dorsal resection must be planned according to whether the radix will be grafted.

Artifacts

Any bony vault reduction exaggerates a low radix and seems to enlarge the preoperative nasal base. Dorsal resection is one of the best examples of the regional interrelationships that expose the second false assumption of reduction rhinoplasty, which states that alterations in the nasal skeleton produce purely regional changes.

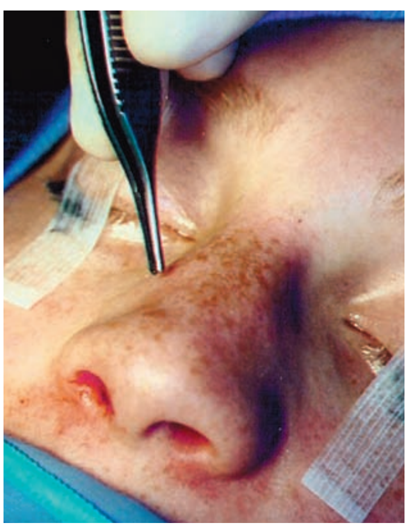
In most noses, dorsal resection shortens the nose, makes the bony vault appear broader, narrows the middle vault (because of resection of the cartilaginous roof), and because the tip cartilages move with the nasal skin (which can now slide cephalad because the dorsal convexity has been lowered), causes the columella to appear lower.



The nostrils may appear flared and the nasal base wider, depending on the degree of dorsal resection.

Technical Details

I use a Fomon rasp for the bony vault and a No. 11 blade (from which the tip has been broken) to resect the cartilaginous dorsum.



The surgeon must observe the effect of dorsal resection on middle vault support. Unless the soft tissues are heavy, the middle vault becomes visibly narrower. Depending on the presence of a high septal deviation, each sidewall may narrow differently. These observations guide the surgeon in the use of spreader grafts and whether they should be placed symmetrically or asymmetrically to correct the high septal deviation.

I always place spreader grafts if I open the cartilaginous roof.

Rasping the bony vault can be performed easily by feel; the dorsum should be smooth and free of any irregularities or flat spots. Cartilaginous resection is performed under direct vision, with essentially the same visibility that is present in open rhinoplasty.

The surgeon should also be aware of an artifact that can appear during dorsal resection, namely a notch in the middorsal line.[2,21] This middorsal notch is an apparent external discontinuity that is both palpable and externally visible, but usually not visible internally. In fact, the true middorsal notch does not represent an actual discontinuity at the junction of the bony and cartilaginous vaults, but rather a soft tissue phenomenon signifying dorsal overresection. The notch occurs at the midpoint of the nasal dorsum at the junction of the thinner upper nasal skin with the thicker lower nasal skin, and represents the center point of the inverted-V that appears after collapse of the unsupported middle vault roof. The treatment is dorsal augmentation. The dorsum should look and feel perfectly smooth after dorsal reduction.

Nasal Spine/Caudal Septum

Because dorsal resection affects columellar position, compensatory adjustments to the caudal septum are often necessary even if its preoperative position was acceptable. Caudal septal resection alone changes the relationship of the columella to the nostril rim and often affects the position of the upper lip and sharpness of the subnasale, which may become, respectively, more retrusive and sharper postoperatively.

Technical Details

If the columella simply needs to be elevated toward the nostril rim without shortening or lengthening the nose, resection of the caudal septum is equally wide at the anterior and posterior ends. If the nose needs to be shortened, resection is triangular with the base anteriorly; if the caudal septum must be rotated to elevate the posterior end, the triangular resection is reversed. Occasionally the nasal spine is large enough to require partial removal with a rongeur. In my experience, however, spine reduction is necessary in less than 10% of cases. Caudal septal resection is 1:1. The surgeon can judge the amount of resection by opposing the incision edges to gauge the effect; it is safer to remove small amounts in increments because an overresection can be difficult to correct.

Treatment of the Lower Lateral Cartilages

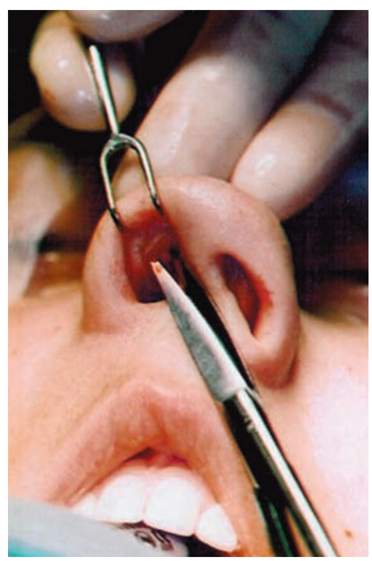
Techniques between the open and closed approaches differ most in the area of the lower lateral cartilages. The exposure and access that facilitates fixation and molding sutures through the open approach is simply not present with the closed approach. However, the thought processes underlying the two approaches are also different. The basic principle of the open approach is to create projection and contour with the patient's own lower lateral cartilages, using struts for stability and grafts only when necessary. Alternatively, my goals are to resect deformity where it exists in any of the three crura, create stability at the external valves, and then provide tip projection with autologous (usually septal cartilage) grafts.

Each segment of the lower lateral cartilages has its own function: the medial crura provide contour and stability for the columella; the middle crura determine, more than any other single factor, tip projection and contour; and the lateral crura provide external valvular support.

Any of these three segments can be hypoplastic or deformed preoperatively. If the medial crura are deficient so that the columella is retracted, I augment the columella with an onlay graft placed through a short intranasal incision at the site of the deficiency. If the middle crura are excessively long, I resect the excess segment. If they are deficient in contour, substance, or length (the usual circumstance in inadequately projecting tips), I add tip grafts.

Technical Details

I treat the lateral crura in one of only four ways: (1) if the lateral crura are orthotopic and well shaped, I do nothing; (2) if the lateral crura are orthotopic but wide, I trim them retrograde no more than 2 to 3 mm; (3) if they are malpositioned but flat, I do nothing to the crura but splint the external valves with septal cartilage or bone; and (4) if the lateral crura are malpositioned and excessively convex, I make a separate incision 3 mm above the alar rim (paralleling the normal location of an orthotopic crus), free the crus from its external and vestibular skin attachments, resect it at the lateral genu, and replace it along the rim, catching the cartilage in the closure.[14]



Upper Lateral Cartilages/Shortening the Nose

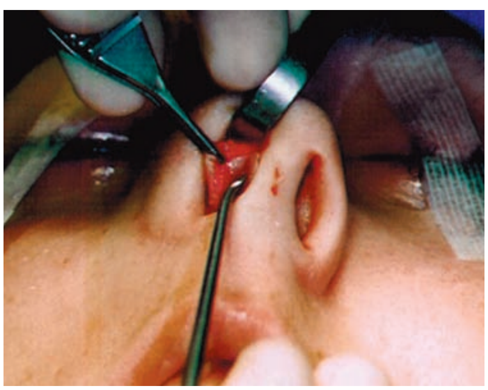
Submucosal resection of the caudal ends of the upper lateral cartilages is really a parallel maneuver to shortening the caudal septum, like shortening the fabric and the lining of a jacket sleeve. It is not routinely necessary, and conservatism is always wise. Mucosa should not be resected to avoid constriction at that site.

The intercartilaginous incision has been condemned in prior years by surgeons who believed that it caused a circular scar contracture at that point. However, the intercartilaginous incision, carried along the anterior septal angle and into the membranous septum, is an incision in three planes. It should not cause a trap-door constriction unless the surgeon resects lining. Instead, those authors were observing the medial collapse of the anterior ends of the upper lateral cartilages after resection of the roof when spreader grafts were not placed.

Septoplasty

The indications for septoplasty are correction of airway obstruction and harvesting of graft material. Therefore in my practice septoplasty is a routine component of almost every primary rhinoplasty.

Before the septoplasty, spreader graft tunnels should be placed if the cartilaginous roof has been opened or if preoperative incompetence of the internal valves exists.

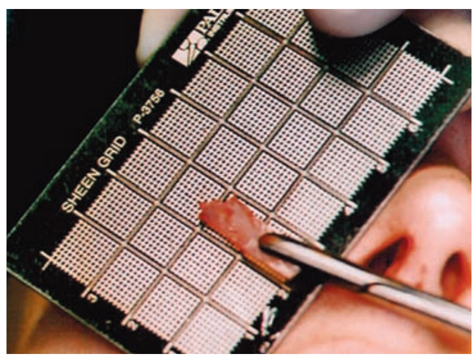


Infiltration is done beneath the mucoperichondrium at the septal angle, and an incision is taken down to cartilage. The sharp end of a Cottle perichondrial elevator is used to slide submucosally along the anterior edge of the septum as high as possible without opening the adhesion between the mucoperichondrium and the anterior edge, and posteriorly just past the caudal edge of the bony arch.

Now that the anterior edge of the septum has been determined and spreader graft tunnels have been defined, the septoplasty can be performed. Fifteen millimeter dorsal and caudal struts should always be left to support the nose.

I perform septoplasty systematically and identically in every patient. I want to harvest grafts that are long and wide enough to be useful, and remove all obstruction. After infiltrating beneath the mucoperichondrial flap with local anesthesia, I incise 15 mm above the caudal septal edge and, using first the sharp and later the blunt end of a Freer elevator, I dissect posteriorly as far as necessary. At the site of the incision, use the sharp end of the Freer to pierce the cartilage and create a plane on the opposite side, and dissect similarly with the sharp and blunt ends of the Freer.

The 15 mm dorsal and caudal struts are never dissected free from their mucoperichondrial attachments, which adds an element of safety to rhinoplasty combined with septoplasty. It is unnecessarily risky to dissect the septum from the anterior (dorsal) edge inferiorly. If the mucoperichondrium is completely stripped from the dorsal strut and an old ethmoid or cartilaginous fracture is present, the nose will collapse.



Holding the mucoperichondrial flaps apart using the Freer, I make a cut 15 mm below the dorsal edge and parallel to it, and then another one parallel to that 8 to 10 mm toward the nasal floor. Using septal forceps, that piece, now cut on three sides, can be twisted so that it breaks at its posterior edge. What comes out is often the best piece harvested, and under the most favorable circumstances provides a 30 mm length of straight cartilage and ethmoid that will make an excellent dorsal graft if one is necessary.

I then use the Cottle elevator to dissect toward the vomerine groove. The same septal forceps can be used with or without an osteotome to remove any bony obstructions. The mucoperichondrial flaps are reapproximated with mattress sutures of 4-0 chromic at the site of the initial incision. If any tears occur, I repair

every one with absorbable sutures and place silicone splints along the septal partition before placing the packs. These splints favor epithelialization and decrease the incidence of septal perforation.

Turbinectomy

Most surgeons do something to the turbinates when there has been an airway obstruction; I am in the minority and do very little. I often crush or outfracture the turbinates, but unless the patient is very atopic and the turbinates are grossly enlarged, I do not resect them. Postoperative persistent chronic rhinitis does occur and is very difficult to correct. Although initially resisted, conservation of turbinates has now been adopted by may rhinoplasty experts.

Graft Placement

At this point I start closing wounds and placing all my grafts, to create contour, reestablish equilibrium, or to support the tip.

Osteotomy

In my practice, the only objective of osteotomy is to narrow the upper third of the nose; therefore not every patient needs one. In fact, there are circumstances in which osteotomies are relatively contraindicated: when the upper third is already narrower than the lower third, when the nasal bones are short, when the patient is 50 years or older and the bones may commute, or when there is a high septal deviation that produces an asymmetrical bony vault (in which case only an osteotomy on the lateralized side is indicated).

There are numerous osteotomy techniques, and some surgeons have strong preferences. I perform intranasal osteotomies with a guarded, curved osteotome, beginning at the base of the piriform aperture, and advance slightly superiorly near the junction of the nasal bone with the nasal process of the maxilla, not in a direct line toward the medial canthus. This is called a *low-to-high osteotomy* and is effective and anatomic, reestablishing the shape of the nasal pyramid.

Alar Wedge Resection

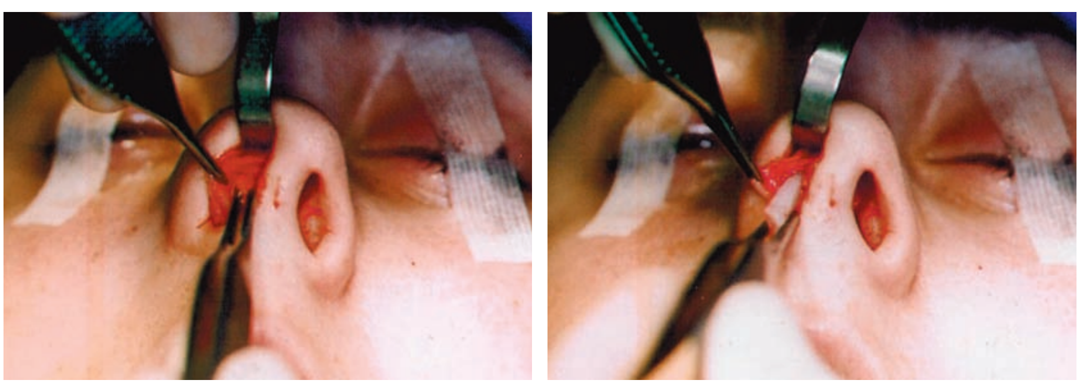
Alar wedge resection is optional, and its indications are specific. Only three technical details are important: (1) placing the incisions slightly out of the crease so that this important anatomic landmark is not destroyed, (2) remembering that the nostril has external and vestibular surfaces, thus the size and direction of the incisions must be adjusted accordingly, and (3) being conservative. Although correction is possible with axial composite grafts, the notching, deformity, and airway obstruction that overly aggressive alar wedges produce should always be avoided.[18]

GRAFTING IN PRIMARY RHINOPLASTY: AUGMENTATION OF SPECIFIC AREAS

Because I view rhinoplasty as an operation of reduction and rebalancing, grafts are necessary in virtually every primary rhinoplasty.[22] Grafts improve nasal balance, correct disequilibrium that existed preoperatively or that was created during the rhinoplasty, and recreate contour or projection that secondarily improves nasal balance. Most noses need at least one of those objectives.

Spreader Grafts

Spreader grafts are the easiest of all grafts to place, and surgeons who are just beginning to learn nasal grafting should learn to place these first.



The grafts are sized to the dimensions of the tunnel and need only equal the length of the upper lateral cartilages. Spreader grafts may be adjusted in width or configuration to provide symmetry: a nose with a high septal deviation toward the left can often be straightened by placing a thinner, curved piece of car-

tilage (with a convexity facing toward the right) on the left, and a wider, straight graft on the right. The aesthetic appearance should be correct—not too wide or too narrow and laterally supported—after the grafts are placed, or they must be redone.

Radix and Dorsal Grafts

In many ways the nasal radix and dorsum is the fussiest area, because the skin is thinnest and imperfections and asymmetries are more likely to be visible. It is here that the first straight piece taken from the septoplasty is often most valuable. Radix grafts are just short dorsal grafts; both must be long enough to blend with the existing anatomy to produce a smooth dorsal line. Each patient requires something individualized but the general principles are that the graft or grafts must fit the configuration of the defect, and that the substance of the graft must suit the soft tissue cover.

Radix grafts are just short dorsal grafts; both must be long enough to blend with the existing anatomy to produce a smooth dorsal line. The graft or grafts must fit the configuration of the defect, and the substance of the graft must suit the soft tissue cover.

In practical terms, this means that patients with thin skin need softer grafts with as perfect a configuration as possible, and patients with heavier skin need stiffer, more substantial grafts to alter surface contour. The grafts should not be made too short or too wide; the surgeon should make certain that they feel and look perfect on the operating table.

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The skin is not shrinking around the graft but rather the graft is supporting the skin, so its effect in the operating room should be instantly visible. Dorsal grafts should feel perfectly smooth and continuous after they are placed. It should not be possible to palpate their edges at the root or their junction with the dorsum either laterally or caudally. I do not fixate dorsal or radix grafts with sutures because it is easier to obtain good contour without doing so. Once a suture is placed, if it is not perfect, the graft must be redone; alternatively, if an unsutured graft is placed slightly high or slightly low, the surgeon can adjust it with forceps or with his or her fingers until it looks correct without injuring the graft by repeated suturing attempts.

Tip Grafts

Tip grafts hold a special place in modern rhinoplasty, because they were the first grafts to be described that represented a change in the old paradigm for using a graft only to fill a regional defect.[23] I do not use struts to provide tip projection, and because the medial crura have not been destabilized by dissection, no strut is necessary. Adequate tip lobular support must be independent of dorsal height, which is one of the reasons that an L-shaped graft is so illogical.

Tip grafts hold a special place in modern rhinoplasty, because they were the first grafts to be described that represented a change in the old paradigm for using a graft only to fill a regional defect.

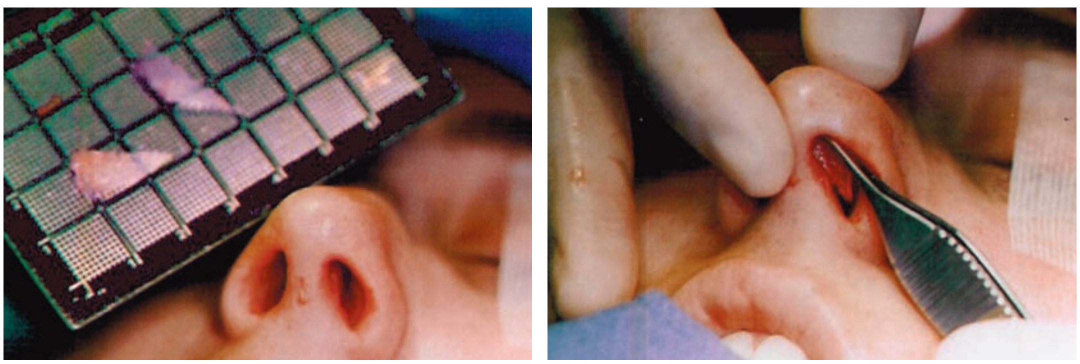
Sheen's method, which is the one I use with essentially no modifications, evolved over the years[24,25] and became an increasingly versatile technique with fewer complications.

The principles of tip grafting are similar to those for dorsal grafts: graft length should be suited to its purpose, and graft substance and contour must match the soft tissue cover and the surgical objective. At one extreme is the patient with small lower lateral cartilages and a hypoplastic, thick-skinned tip (in which multiple solid or lightly softened grafts are needed for proper support); at the other extreme is the patient with thin skin and good tip lobular shape who only requires soft, filler grafts to lift the point of greatest tip projection.

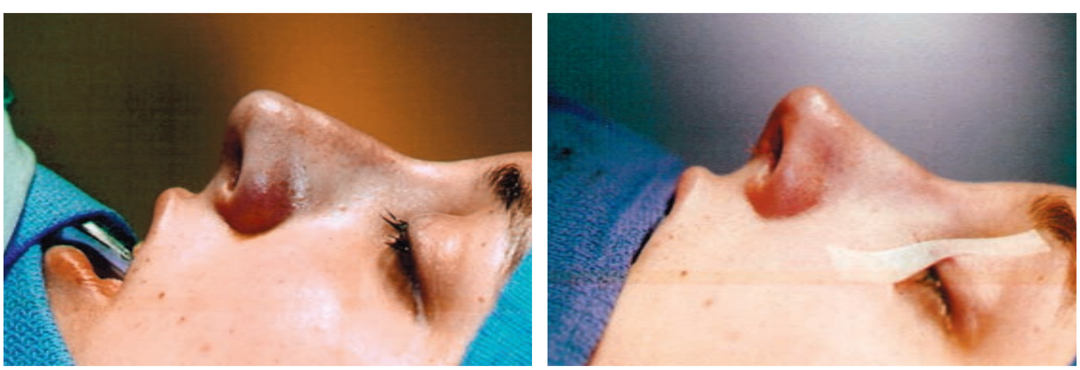
There are two basic techniques for tip grafts. Which one the surgeon uses depends on the shape and intrinsic support of the tip lobule. If the tip is full or supported, by which I mean that the patient has lower lateral cartilages but just needs improved definition, the surgeon wants to create shape without adding much projection. Here, multiple softened grafts work well. They are fed into the lobule one by one; the surgeon must keep in mind normal anatomy and judge the amount and placement by the shape and support that can be felt.

If, on the other hand, the tip is unsupported and undefined, the surgeon will need to place a solid cartilage or bone graft first to establish projection and define the angle of rotation (the angle that the lobule makes with the horizontal plane). After placing the first graft, the tip usually will look artificial and pointed. That is the reason that Sheen abandoned the original, single graft design in the mid-1980s. This aesthetic problem can be solved by adding softened grafts anterior to the defining graft to fill the lobular part and create the contour the patient desires. The more grafts added, the rounder the tip will become. The infracartilaginous access incision is closed carefully, with care taken to ensure that the alar rims are symmetrical and undistorted.

The access incision parallels the middle crura segment, and undermining is limited.



Graft number and substance must suit their purpose; in the case shown, only two grafts were needed to increase lobular projection and contour. The wound should be closed meticulously.



The patient is shown preoperatively and immediately postoperatively after radix, spreader, and tip grafts were placed.

ROUTINE POSTOPERATIVE CARE

I place nasal packs in almost every patient in whom I have performed septoplasty or placed grafts, and I place an external splint to immobilize the reconstruction for 1 week, until the packing can be removed without pain or bleeding. I pack the nose with Adaptic gauze impregnated with bacitracin and mupirocin ointment and layered over No. 18 Fr suction catheters placed in the floor of each nasal airway for comfort. The nasal splint is created from layers of ¼-inch paper and then cloth tape, covered with four strips of 2-inch plaster that have been cut to conform to the patient's nose.

The tape and splint should be placed purposefully but not tightly. It is neither the taping nor the dressing that creates the nasal shape, but rather the cartilaginous support beneath.

▪ ▪ ▪

Tip projection, particularly the supratip dip, is not produced by pressing nasal skin into a concavity in the nasal dorsum but rather by creating tip projection that drapes the skin slightly forward of the supratip.

It is a mistake to think that thinning the skin, suturing it, or injecting it with steroids will create the supratip depression.

Intraoperative and Postoperative Photographs

When I started performing rhinoplasty in private practice, I understood very little about it. The phenomena that occurred during rhinoplasty did not correlate to anything written in the atlases I had studied.

Rhinoplasty is a feedback operation in which the surgeon must learn to interpret what he or she sees during surgery and adjust accordingly. It is a right-brain operation. I know of no better way to learn than to take sequential photographs during the operation and study them after surgery.

Postoperatively the surgeon learning rhinoplasty should see each patient frequently (monthly at first) and document postoperative changes. Tip projection in some noses changes after 2 months; in others it does not. Dorsal reduction lengthens some noses and shortens others. Tip grafts reshape large, voluminous tips in a manner that is different from tip grafts of hypoplastic tips. The only way to understand such changes is through rigorous documentation and meticulous follow-up.

CONCLUSION

Rhinoplasty deserves its reputation as a difficult operation, but it is not more technically or anatomically difficult than most plastic surgical operations. It is different. What makes rhinoplasty difficult is its phenomenology, which many surgeons have never learned or do not recognize when they see it.

The nasal skeleton imparts half of the shape of the nose, but the soft tissue skin sleeve imparts the other half—if it didn't, there would be no such thing as supratip deformity. The ability to judge the nuances of surface shape is the chief advantage of the closed approach, because it determines how much control the surgeon has over the postoperative result. The surgeon's goal in rhinoplasty is not to see the skeleton perfectly; it is to achieve the patient's aesthetic and functional goals as accurately as possible without introducing new deformities.

Rhinoplasty remains an operation that can be readily learned by a dedicated surgeon, and because of its unique anatomic variations and the surgical goals set by both patient and surgeon, remains endlessly fascinating.

KEY POINTS

- The nasal skeleton imparts half of the shape of the nose but the soft tissue skin sleeve imparts the other half—if it didn't, there would be no such thing as supratip deformity. The ability to assess the support, shape, and nuance of the nasal surface with the skin sleeve in its resting tension and position is the primary advantage of closed rhinoplasty, which is why I use it exclusively.
- It is impossible to understand the logic of closed rhinoplasty if the surgeon believes that his or her primary goal is to see the skeleton perfectly. It is not. The surgeon's objective is to achieve the patient's aesthetic and functional goals as accurately as possible without introducing new deformities.
- The most common indication for revision rhinoplasty, based on my reported series of 150 consecutive patients, was an iatrogenic deformity (89% of patients in that series). The surgeon must be constantly aware of this fact as he or she selects and performs any rhinoplasty technique.
- Therefore it follows that the nasal skeleton is actually irrelevant, except insofar as it influences surface contour or airway. Managing the skeleton is only half of the surgeon's job.
- Closed rhinoplasty does not mean blind rhinoplasty.
- It has been my contention over the years that rhinoplasty is difficult primarily because the traditional reduction model is insufficiently complex.
- Far from being independent, nasal regions are interdependent, and these structural interdependences are not only predictable but also necessary for accurate

preoperative planning, interpretation of intraoperative nasal appearance, postoperative success, and correction of secondary deformities.

- One paramount reason that rhinoplasty is difficult to learn is that it is a feedback operation that cannot be premeasured and premarked. The surgeon must recognize the changing intraoperative appearance and respond accordingly. Rhinoplasty is a right-brain operation. I know of no better way to learn than by taking sequential photographs during the operation and studying them after surgery.
- I do not believe that there are any contraindications to closed primary rhinoplasty. In fact, the more difficult the deformity and the more difficult the case, the stronger the argument that can be made for limiting access, limiting incisions, and minimizing morbidity.
- Skin volume and thickness, anatomic strength and structure, and the bony and soft tissue elements of the remaining face have all been predetermined. Unless the surgeon is planning a major craniofacial rearrangement, it is impractical to create nasal aesthetics that are defined by artistic ideals because the surgeon does not really control any feature but the nose.
- Although it may be intuitively obvious that only skin thickness affects rhinoplasty strategy, skin distribution is a factor as well.
- Simple lower lateral cartilage reduction cannot convert a poorly shaped lobule into a well-shaped lobule.
- Dorsal reduction and augmentation profoundly affect the apparent size of the nasal base; the higher the nasal dorsum (and the longer the distance from root to tip), the smaller the nasal base will appear. The reverse is also true.
- Dorsal length and height, balanced against lower nasal size, determines the attractiveness of nasal proportion. Therefore low radix or low dorsum are most important in patients with thick skin (whose soft tissues may not shrink adequately), or in patients who complain about the projection and size of their lower nose (which often signals a proportion problem, not a dimension problem).
- Tip projection reflects cartilage strength, not skin volume. Adequate tip projection is necessary for a straight profile line.
- An oversized, unbalanced lower nose does not mean that the patient has excessive tip projection. Skin volume and cartilage strength are different anatomic entities. Any definition of tip projection should allow the surgeon to distinguish between the two.
- A narrow middle vault signals an internal valve that is already compromised. The middle vault narrows after cartilaginous roof resection, so hump removal can inadvertently worsen the airway.
- Lateral crural malposition signals an external valve that is compromised. So lateral crural reduction can inadvertently worsen the airway. This often accompanies the box or ball tip and is usually present on the cleft side in the cleft lip nasal deformity.

- Rhinoplasty is not really an operation for the nasal skeleton. It is an operation for the skin surface and lining in the sense that the beauty of the external shape and the stability of the airway are the only real objectives. The skin sleeve alone constitutes 50% of the patient's result. Skeletal changes are a means to that end.
- The goal of rhinoplasty, therefore, is not reduction. It is reduction and/or rearrangement to produce the best possible airway and the best possible shape with the greatest predictability without introducing new, iatrogenic deformities.
- In most noses, dorsal resection shortens the nose, makes the bony vault appear broader, narrows the middle vault (because of resection of the cartilaginous roof), and because the tip cartilages move with the nasal skin (which can now slide cephalad because the dorsal convexity has been lowered), causes the columella to appear lower.
- I always place spreader grafts if I open the cartilaginous roof.
- Before the septoplasty, spreader graft tunnels should be placed if the cartilaginous roof has been opened or if preoperative incompetence of the internal valves exists.
- The 15 mm dorsal and caudal struts are never dissected free from their mucoperichondrial attachments, which adds an element of safety to rhinoplasty combined with septoplasty. It is unnecessarily risky to dissect the septum from the anterior (dorsal) edge inferiorly. If the mucoperichondrium is completely stripped from the dorsal strut and an old ethmoid or cartilaginous fracture is present, the nose will collapse.
- Spreader grafts are the easiest of all grafts to place, and surgeons who are just beginning to learn nasal grafting should learn to place these first.
- Radix grafts are just short dorsal grafts; both must be long enough to blend with the existing anatomy to produce a smooth dorsal line. The graft or grafts must fit the configuration of the defect, and that the substance of the graft must suit the soft tissue cover.
- The grafts should not be made too short or too wide; the surgeon should make certain that they feel and look perfect on the operating table.
- Tip grafts hold a special place in modern rhinoplasty because they were the first grafts to be described that represented a change in the old paradigm for using a graft only to fill a regional defect.
- The tape and splint should be placed purposefully but not tightly. It is neither the taping nor the dressing that creates the nasal shape, but rather the cartilaginous support beneath.
- Tip projection, particularly the supratip dip, is not produced by pressing nasal skin into a concavity in the nasal dorsum but rather by creating tip projection that drapes the skin slightly forward of the supratip.
- Rhinoplasty is a feedback operation in which the surgeon must learn to interpret what he or she sees during surgery and adjust accordingly. It is a right-brain operation. I know of no better way to learn than to take sequential photographs during the operation and study them after surgery.

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Byrd's Approach

H. Steve Byrd

PREOPERATIVE ASSESSMENT AND PLANNING

Every rhinoplasty should begin with a thorough clinical analysis, which is required for an accurate diagnosis. Surgeons need to develop a personal approach to analysis that yields consistency and accuracy in diagnosis. My approach (see Chapter 34) identifies the ideal proportion between the nose and face and proportional balance within the nose. Three key dimensions determine the result: (1) ideal nasal length, (2) ideal nasal tip projection, and (3) ideal radix projection.

Plans for altering the dimensions of the nose may include lengthening or shortening of the nose; maintaining, decreasing, or increasing the nasal tip projection; maintaining, decreasing, or increasing the radix projection; and maintaining, decreasing, or increasing the projection of the nasal dorsum. The width of the nose is evaluated in a similar manner. Osteotomies and alar base resections are considered on the basis of these findings.

Septal deviation

Short nasal bones with inverted-V deformity

The second part of my analysis is focused on the identification of anatomic findings that place the patient at risk for secondary deformity, which necessitates special technical considerations. These special anatomic features include dorsal and caudal septal deviation and short nasal bones with inverted-V deformity.

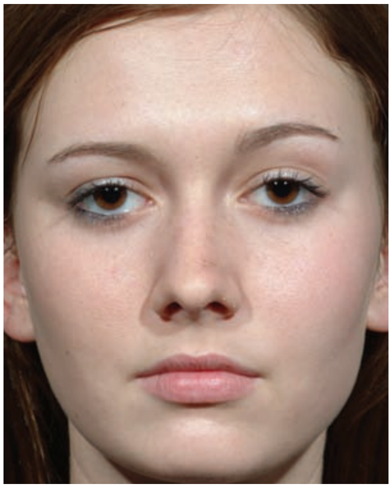
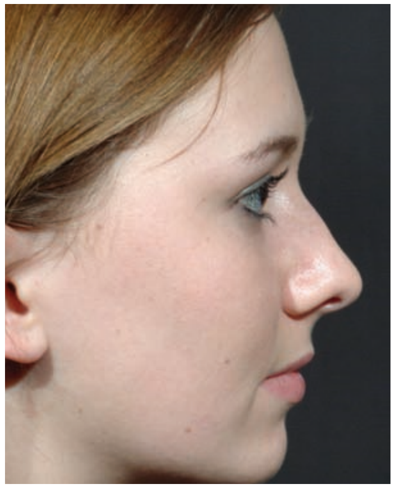
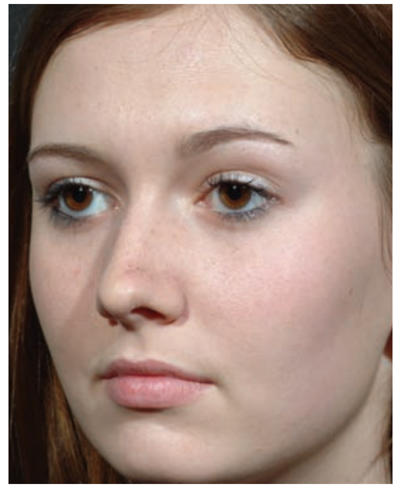

Weak lower lateral cartilages with inadequate tip projection


Alar malposition


Short nose

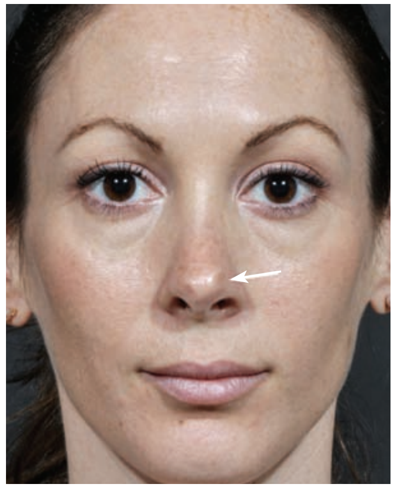

Cleft nasal deformity

Other deformities include weak lower lateral cartilages with inadequate tip projection, alar malposition, short nose, and cleft nasal deformity.


With a diagnosis established, the next step is to choose between an open and a closed approach. I perform a closed rhinoplasty when tip morphology, definition, and projection are good and the supporting structures are symmetrical. A typical case is a patient with good tip definition, good tip support and projection, and a small dorsal hump deformity.

I perform a closed rhinoplasty when tip morphology, definition, and projection are good and the supporting structures are symmetrical.



A closed approach is useful in minor secondary revisions in which onlay or camouflage techniques are performed to eliminate imperfections of contour *(arrow).*

An open approach is used in practically all other cases. It is particularly suited for the correction of dorsal and caudal septal deviation when the creation of balance in the dorsal aesthetic lines is particularly problematic. The dorsal aesthetic lines and internal valve are well managed with the open approach in patients having a collapsed midvault. This approach is especially appropriate for the management of nasal tip deformities, which can include asymmetries that necessitate suture techniques and grafting.

An open approach is particularly suited for the correction of dorsal and caudal septal deviation and for the management of nasal tip deformities.

An open approach is helpful to readily achieve an ideal relationship between the tip and dorsum and alteration of nasal tip projection. It is also useful for creating major structural changes in both primary and secondary rhinoplasty that involve rib and septal cartilage grafts.

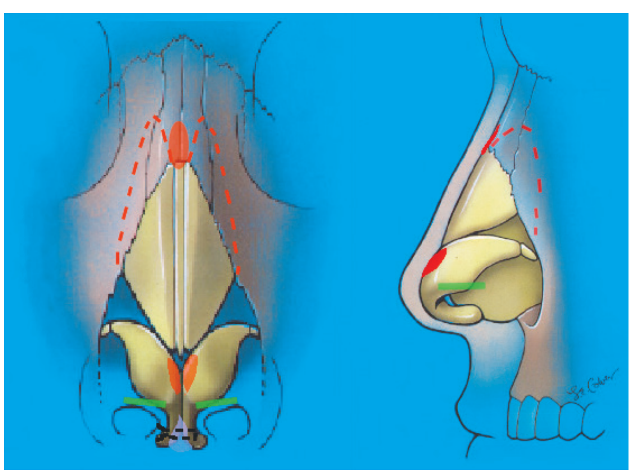
OPERATIVE TECHNIQUE

Closed Approach

I perform most closed rhinoplasties through an intracartilaginous incision, removing the medial edge of the cephalic portion of the lateral crus as the dorsum is approached. I make symmetrical incisions and perform a symmetrical dissection of the dorsum to prevent deviation. The volume of local anesthetic is 3 ml or less to minimize soft tissue distortion.

After the dorsum is symmetrically degloved, I reduce the bony hump using a rasp and then excise the residual cartilage over the midvault. This is done either directly as a composite of upper lateral cartilage and septum for small projections or as a component removal after the upper lateral cartilages are detached from the septum. The latter is the preferred technique when the resection exceeds 2 mm. Repair of the upper lateral cartilages to the nasal septum requires a tapering of the width from the keystone down to the anterior septal angle. This may mean that at the keystone the upper laterals are sutured to the septum, and a spreader flap or graft is placed to maintain maximum width, whereas at the midvault some narrowing of the width is expected and sometimes necessitates direct suturing to the septal cartilage itself. At the anterior septal angle, the upper laterals may be unified, with complete tapering from the keystone to the anterior septal angle. I typically use 4-0 chromic gut in the closure and place it as a mattress suture beneath rather than across the dorsal septal edge to prevent suture cutting or removal if refinement of the cartilage edges is required.

Repair of the upper lateral cartilages to the nasal septum requires a tapering of the width from the keystone down to the anterior septal angle.



This patient's midvault was preserved, and only a small keystone hump of bone and cartilage was removed.

Lateral percutaneous J-shaped osteotomies (along the frontal process of the maxilla with a curvilinear path to the open roof of the bony dorsum) are then performed and infracture established. Where no open roof of the bony dorsum exists, I tend to add a medial oblique osteotomy to complete the medial component of the J-shaped osteotomy and allow infracture. If infracture is needed, the dorsum and final contour are always reinspected.

If a patient has ultrathin skin, I frequently insert a thin AlloDerm (LifeCell, Branchburg, NJ) graft over the dorsum to extend from the keystone to the anterior septal angle. AlloDerm decreases the visibility of small bumps or irregularities that can be seen through ultrathin skin. To correct high soft triangle facets and improve alar rim aesthetics, small alar contour grafts from the septum are added along the alar rims through small infracartilaginous incisions. The medial footplates are plicated after removal of interposing soft tissue to narrow the columellar base.

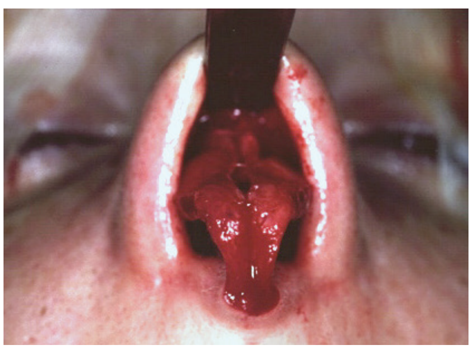
Intranasal incisions are closed with 5-0 chromic gut suture. The dorsum is secured with 3M Micropore tape that extends distally across the supratip area for maximum compression. An Aquaplast splint is then applied over the Micropore tape. I do not use nasal packing unless I have combined septal work with partial resection of the inferior turbinates. If septal resection is performed without inferior turbinate resection, Xeroform gauze is placed along the septum and left in place for the first 24 hours to prevent bleeding. The splint is removed 1 week postoperatively, and Silastic gel is applied at night over the bridge of the nose for the next 6 weeks. These gel strips are typically 40 mm long by 10 to 12 mm wide and extend from the radix to the supratip area. I find this routine of dorsal compression with Silastic gel material extremely beneficial in reducing edema and in minimizing keystone irregularities.

Open Approach

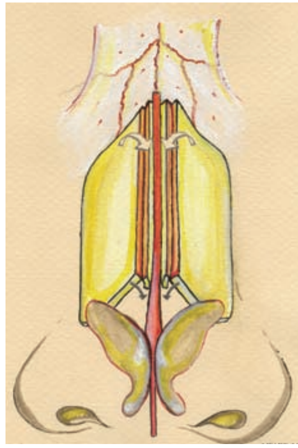
My preferred approach in open rhinoplasty involves an infracartilaginous incision connected with a transcolumellar stair-step incision at the narrow point of the columella. I prefer a lateral to medial dissection of the lateral crus over the dome and down the columella to prevent damage to the curl of the caudal margin of the lateral crus in the area of the soft triangle. Dissection is maintained immediately against the perichondrial surface, and all soft tissues are elevated on the skin. The dorsum and lateral crura are dissected symmetrically. When the deformity is more exaggerated on one side than the other, I nevertheless try to dissect symmetrically to prevent bias in the postoperative healing phase.

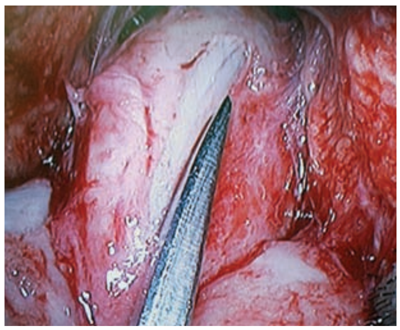
I inject a far more generous amount of local anesthetic with open rhinoplasty, frequently up to 10 to 12 ml. Because harvest of septal cartilage grafts is a typical component of my open rhinoplasty, a conscious decision about the approach to the septum is foremost in my plan. The basic options are a dorsal approach to the septum with detachment of the upper lateral cartilages or a more limited Killian-type midseptal resection. I use a Killian approach for septal harvest when the midvault is normal and when I am shortening the nose and wish to leave the caudal mucoperichondrium attached to the septum to serve as an anchor for cephalic rotation. In most other situations, a dorsal approach to the septum is preferred.

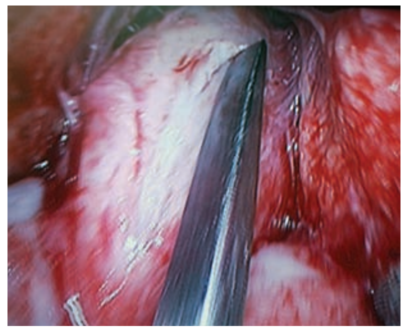
I use a Killian approach for septal harvest when the midvault is normal and when I am shortening the nose and wish to leave the caudal mucoperichondrium attached to the septum to serve as an anchor for cephalic rotation.



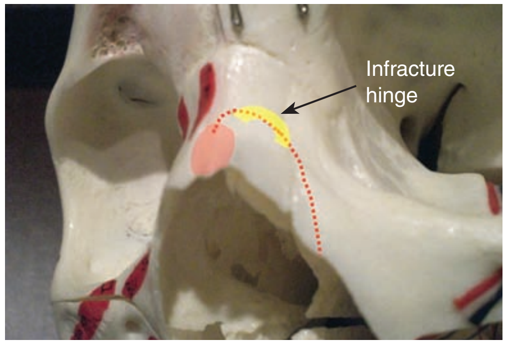
I prefer to complete septal harvest before working on the dorsum or performing osteotomies to prevent bleeding that can obscure the field.

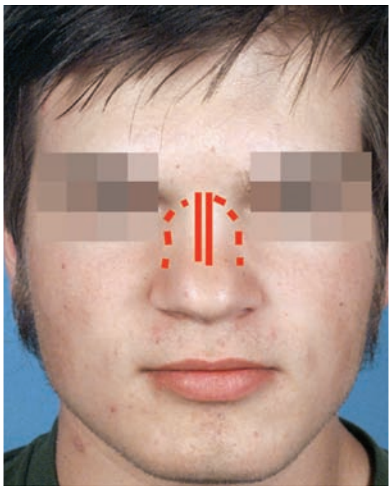






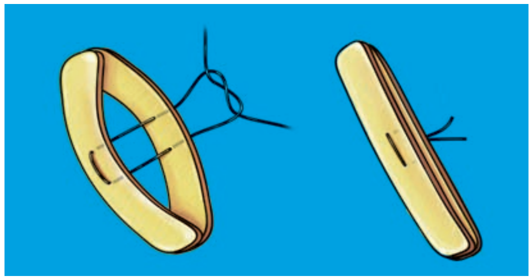
After degloving and septal harvest are completed, I focus on the dorsal contour. I predetermine appropriate nasal tip projection, and based on this decision, I plan the dorsal modification. If it involves reduction, I begin with bony reduction, and when the hump exceeds 3 mm, I frequently use a double-guarded osteotome as my first measure of resection. This is followed with a fine rasp to precisely adjust the level of the bony dorsum. A component reduction of the cartilaginous midvault is then carried out, beginning with the midseptum. I remove this with a No. 15 blade. In most patients, I turn down autospreader flaps of the upper lateral cartilage rather than resect the cartilage.[1] These flaps frequently eliminate the need for spreader grafts but do not preclude their use. The beauty of these flaps is that sutures or additional fixation is not needed. I free the upper lateral cartilage as it extends beneath the nasal bone at the keystone. This not only facilitates the folding over of the spreader flap, but it also preserves the underlapping of the upper lateral cartilage, which serves to stabilize the infracture and maintain the dorsal aesthetic lines as they cross the keystone. The *left* image shows preservation of the T of the upper lateral cartilage. The image on the *right* shows the beginning of a medial oblique osteotomy just lateral to where the upper lateral cartilage underlaps the nasal bone.





Lateral percutaneous osteotomies are performed using a sharp 2 mm osteotome. These osteotomies start low in the frontal process of the maxilla and then course curvilinearly back to the cephalad point of the open roof, creating a J configuration *(red dashed line).* This curve occurs at the divergence of the nasal bones and is actually the hinge point of the osteotomy, leaving the bony width of the radix at the intercanthus undisturbed. These osteotomies are my routine. In patients with very widely displaced nasal bones and a wide radix, osteotomies need to be continued cephalad. In these cases I almost always perform a paramedian ostectomy to prevent a rocker effect when infracture is carried out.

In the absence of an open roof, a medial oblique osteotomy is added to allow infracture. These osteotomies begin about 2 mm lateral to the midline to preserve the underlapping upper lateral cartilages. They are directed cephalad and laterally at a 30- to 45-degree angle to the bony thickening along the zone of divergence of the nasal bones.

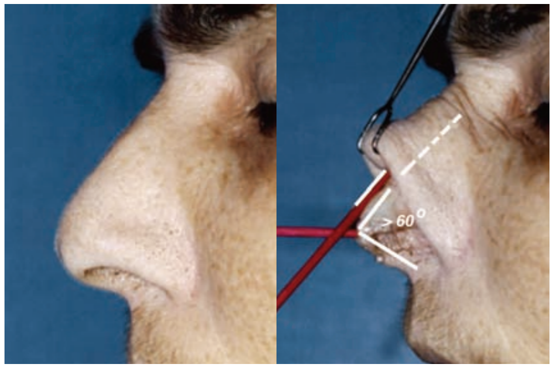


On completion of infracture, attention is redirected to the dorsum, particularly the dorsal aesthetic lines. I find that establishment of the dorsal aesthetic lines is one of the most challenging parts of rhinoplasty. I have observed that modification of the osteotomy with upper lateral cartilage preservation has improved the transition across the keystone and diminished my use of primary spreader grafts, except in patients who have dorsal septal deviation. In these patients I almost always add a reverse-curve spreader graft on the concave side of the septum. See Chapter 51 for more details on the indications for autospreader flaps versus traditional spreader grafts.

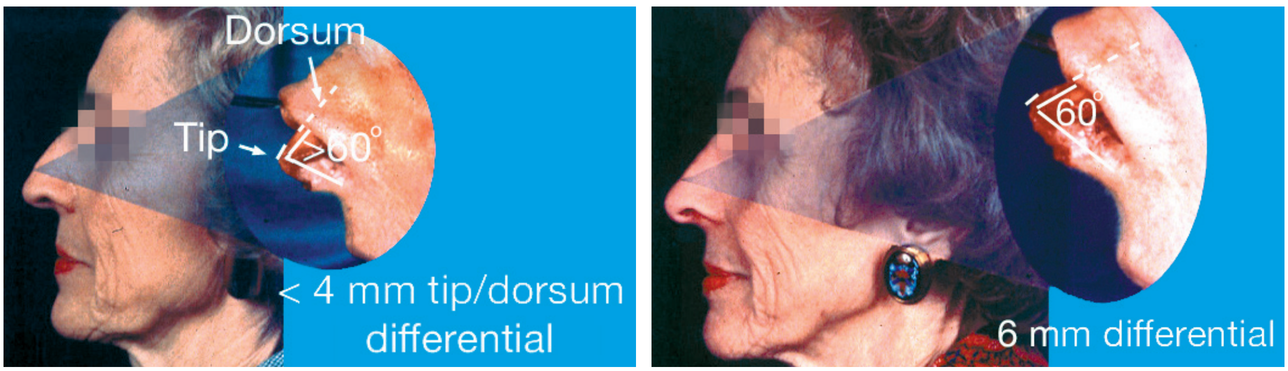
After osteotomies are completed and the midvault adjusted, attention is turned to the tip. All decisions regarding the height of the dorsum are made preoperatively based on where the tip should be placed and maintained. The plan now focuses on the tip-dorsum relationship. The table below emphasizes that the differential between the plane of tip projection and the plane of the dorsum is related to the thickness of the skin, whereas the angle formed by the medial edge of the lateral crus and the anterior septal edge is critical in differentiating between a supratip break and a straight dorsum.

Correlation of Skin Thickness With Ideal Tip Characteristics

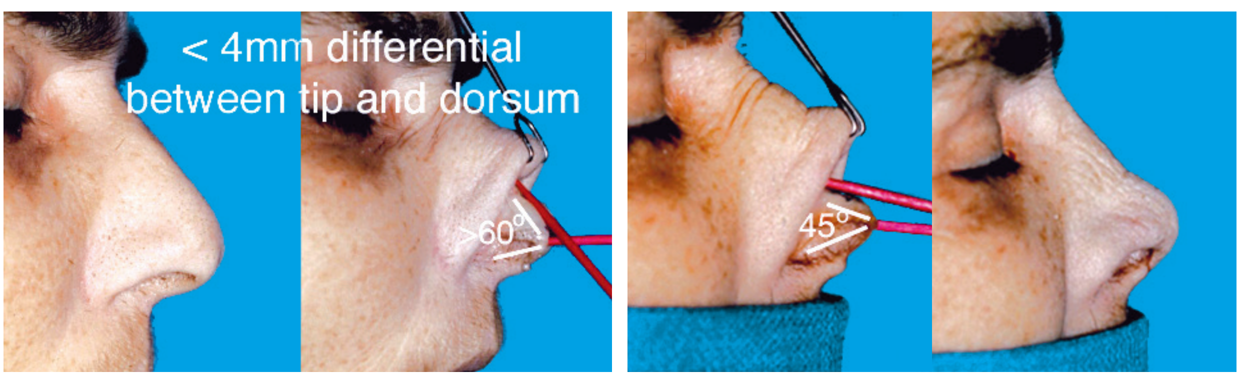
Skin Thickness	Differential Between Tip and Dorsum (mm)	Medial Lateral Crus–Anterior Septal Angle (degrees)	
		Supratip Break	Straight
Thin	6	45	60
Medium	7-8	45	60
Thick	8-10	45	60
Thick with scar	10-12	45	60



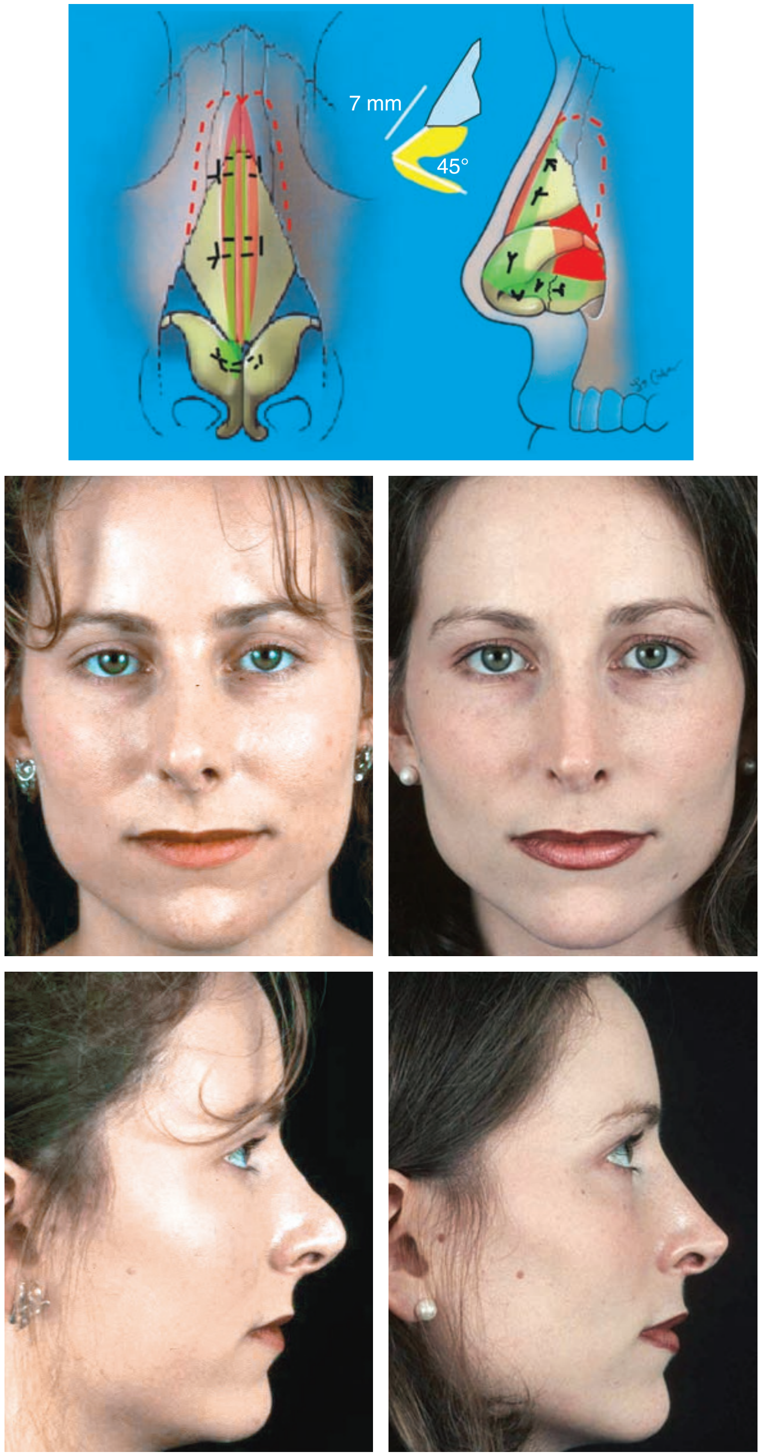
This thin-skinned fresh cadaver has a pollybeak tip. The differential between the tip and dorsum is less than 4 mm.



Open rhinoplasty in this patient resulted in an appropriate, straight dorsum-tip. The dorsum was lowered and the tip was raised to form a 6 mm differential. The medial edge of the lateral crus was affixed to the dorsum, creating a 60-degree angle from dome to dorsum.

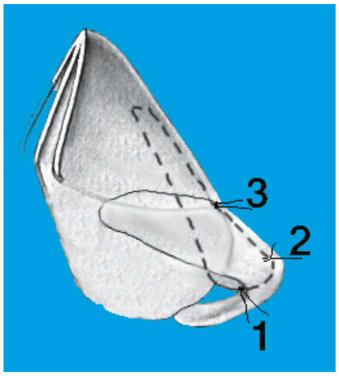


The same cadaver model demonstrates a supratip break when the medial edge of the lateral crus is moved forward creating a dome-to-dorsum angle of 45 degrees.



This patient had thin skin and supratip scarring that was corrected with a tip-to-dorsum differential of 7 mm (to allow for scarring) and a dome-to-dorsum angle of 45 degrees to produce a supratip break. As skin thickness increases, so should the differential between the tip and dorsum.

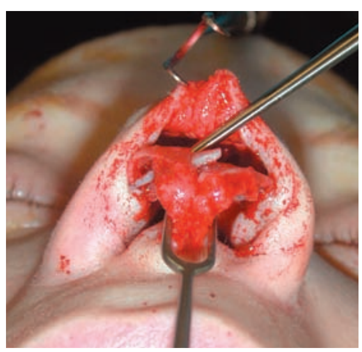
As skin thickness increases, so should the differential between the tip and dorsum.



I typically secure the tip-lobule complex to a fixed structure, with one point of fixation at the junction between the cephalic edges of the middle and medial crura *(1),* a second point of fixation between the domes *(2),* and a third point at the junction of the medial edges of the lateral crura and the anterior septal angle *(3).*

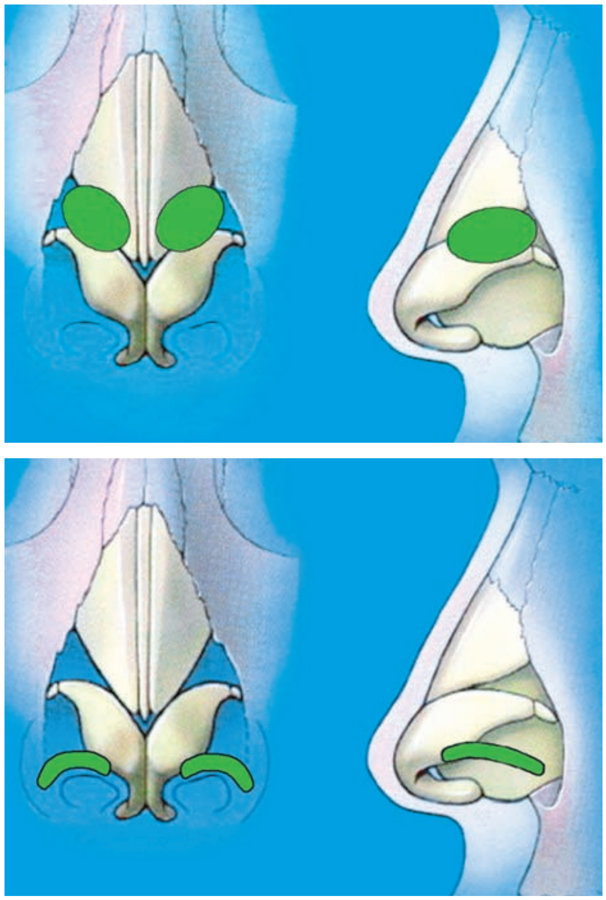
The supporting structure can be the native caudal septum in patients with long noses that are being shortened, a fixed columellar strut (fixed to the caudal septum and the tip-lobule complex), or a septal extension graft, as described in Chapter 23.

The lateral crus is typically trimmed medially to enhance tip definition. I extend the cephalic trim laterally in the area of the scroll in cases in which I prefer some retraction or cephalic elevation of the rim margin.



In patients with alar malposition or otherwise weak lower lateral cartilages in whom the external nasal valve is at risk, I supplement structure with alar strut grafts. These are placed on the lining side of the native cartilage and typically extend from the domes into a pocket along the alar margin and outward to near the piriform aperture. These grafts have a similar purpose but a different orientation than the lateral crural strut graft described by Gunter. The sutures I typically use to complete tip definition and stabilize the tip-lobule complex are domal mat-

tress sutures and interdomal sutures. Spanning sutures are used less frequently and must be carefully adjusted so the external valve is not compromised. I almost always use alar strut grafts to stabilize the external nasal valve when sutures are needed to create a lot of domal angulation and accentuation.



Two varieties of grafts are often used to control the shape of the ala: alar contour grafts and alar batten grafts. Alar contour grafts are only 2 to 3 mm wide and extend along the alar margin approximately 8 to 10 mm. They are placed in pockets along the alar rim. I find them useful for flattening or decreasing the arch of the alar margin and for correcting the high facet in the soft triangle. An alar batten graft is placed between the skin and lateral crus. It helps to correct concavities or irregularities in the lateral crus.

After the internal and external incisions are closed, I attend to the alar bases. Alar base resection is usually not a required step but is a very powerful tool in balancing and reshaping the nostrils. It can be used to decrease the lobular portion only, to narrow the width of the nose, and to lower the base when a vertically oriented sill component is present.

Alar base resection is usually not a required step, but it is a very powerful tool in balancing and reshaping the nostrils.

I prefer a step incision with a medial triangular flap of the sill inserted along the visual rim to minimize evidence of scar crossing the margin of the nostril in this area. With alar base resection completed, an external dressing is applied, similar to the previous description.

POSTOPERATIVE CARE

We remove the external Aquaplast splint and transcolumellar skin sutures 5 to 7 days postoperatively. When Doyle splints and/or intranasal packing is placed, it is removed at this time. We immediately secure a 1 by 4 cm Silastic gel strip firmly across the nasal dorsum with three pieces of Micropor tape. This gel strip begins in the supratip area and ends at the bony radix but does not cover the nasal tip. It is worn constantly for 3 days. The patient can then remove it in the morning and reapply it at night, wearing it 10 to 12 hours a day for 6 weeks. This minimizes morning edema that can be present along the bridge and improves the overall contour of the nasal dorsum.

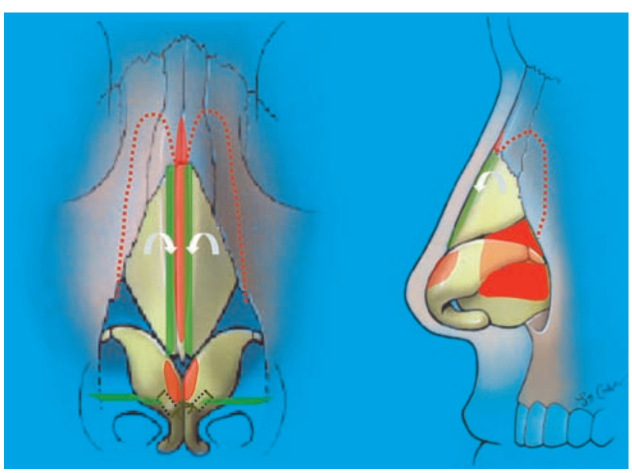
We perform saline nasal washes two or three times a day. This is most vigorous when septal and turbinate work has been performed.

For patients with thick-skinned noses with poor conformation of the soft tissues to the underlying skeleton, we frequently inject 0.1 ml of Kenalog-40 (triamcinolone) diluted 1:1 with Xylocaine 0.5% in the supratip area. This early injection diffuses in the gelatinous coagulum between the soft tissues and skeleton and offers more shaping of the soft tissues.

For patients showing continued nasal congestion and airway obstruction, 4 to 6 weeks postoperatively we frequently initiate a course of nasal steroids. Photos are normally obtained 6, 12, and 18 months postoperatively. If revision work is needed, it is deferred until 1 year postoperatively, except in cases of early postoperative injury that results in obvious malalignment.

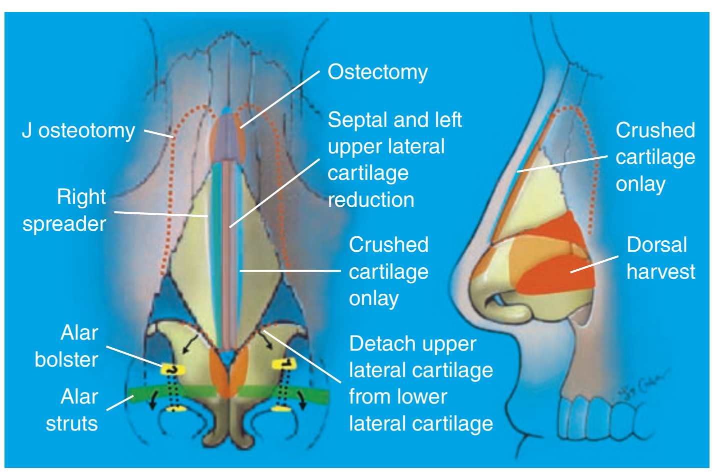
CASE ANALYSES

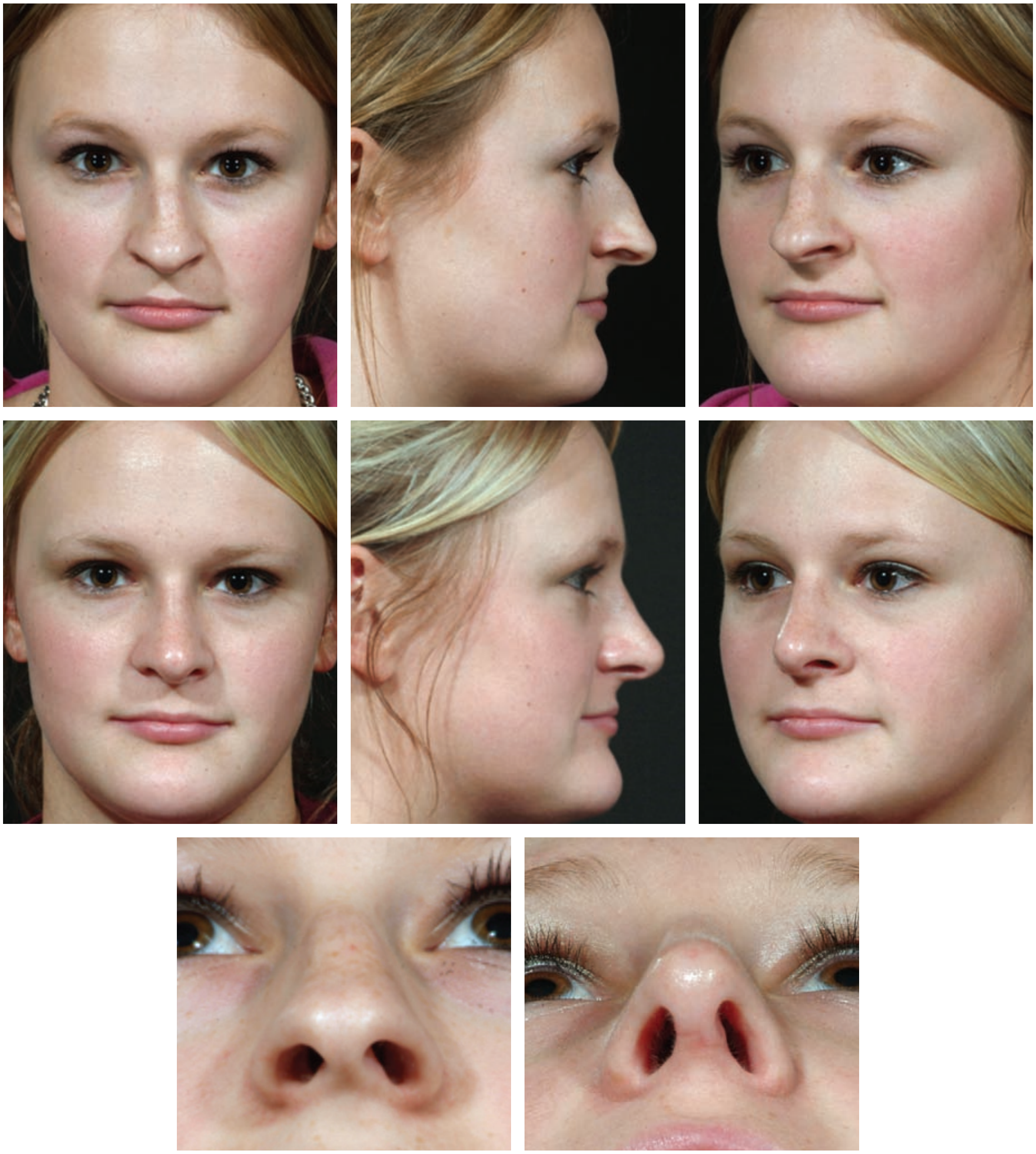
This 28-year-old woman presented with a high dorsum and a very wide nose whose dorsal aesthetic lines flared widely onto the nasal tip. The lateral crura of the lower lateral cartilages were cephalically rotated, the tip and base were broad, and the skin was of medium thickness. She desired a less prominent, narrower, and more refined nose.



An open rhinoplasty was performed with a component dorsal reduction and osteotomies. The upper lateral cartilages were preserved at the keystone so that infracture allowed a smooth transition onto the midvault, where autospreader flaps were used. The tip was modified with cephalic trim of the lateral crura, bilateral alar strut grafts, and domal mattress and domal unification sutures.

This 19-year-old woman presented with a high bony and cartilaginous dorsum. She had a long nose and a drooping tip. Her alae were high and arched, with the right alar base higher than the left. She had dorsal and caudal septal deviation with the midvault off to the left and the tip back to near midline.





Her surgery involved a component dorsal reduction; J osteotomies with infracture requiring a small bony ostectomy on the left side nasal bone at the keystone; left upper lateral cartilage reduction; a right primary spreader graft; a crushed cartilage onlay to cover the keystone transition, detachment of the lower lateral cartilages from the upper lateral cartilages at the scroll; insertion of bilateral alar strut grafts sutured to the domes and caudal aspect of the lower lateral cartilages; and then downward rotation of the alar complex by insertion of the ends of the struts in pockets along the base that forced caudal movement of the rims. The delaminated alar complex was then sutured with through-and-through bolster sutures to secure the lining, cartilage, and skin in its new caudal position.

KEY POINTS

- I perform a closed rhinoplasty when tip morphology, definition, and projection are good and the supporting structures are symmetrical.
- A closed approach is useful in minor secondary revisions in which onlay or camouflage techniques are performed to eliminate imperfections of contour.
- An open approach is particularly suited for the correction of dorsal and caudal septal deviation and for the management of nasal tip deformities.
- Repair of the upper lateral cartilages to the nasal septum requires a tapering of the width from the keystone down to the anterior septal angle.
- I use a Killian approach for septal harvest when the midvault is normal and when I am shortening the nose and wish to leave the caudal mucoperichondrium attached to the septum to serve as an anchor for cephalic rotation.
- As skin thickness increases, so should the differential between the tip and dorsum.
- Alar base resection is usually not a required step, but it is a very powerful tool in balancing and reshaping the nostrils.

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